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ABSTRACT

Intended as a companion piece to volume 2 in the Method Series, Environmental Health Planning (CE 024 230), this second of six volumes in the International Health Planning Reference Series is a combined literature review and annotated bibliography dealing with environmental factors in health planning for developing countries. The review identifies literature relevant to the areas of clean water supply, wastewater and excreta disposal, treatment of disposal of solid wastes, and pest control (including the use of pesticides). Additional environmental health hazards discussed to a lesser extent are occupational health issues, radiation hazards, air quality, food sanitation, noise, and housing issues. The 462 references included in the review are contained in the bibliography which divides the references into these areas: general environmental health; water; wastewater and excreta disposal; solid wastes; pesticides, pests, and pest control; radiation; occupational health; air quality; food sanitation; noise; and housing. The format for each entry is author, title, source or publisher, date of publication, and annotation. (YLB)

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International Health
Planning Reference Series

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Environmental Health References

Selected Bibliographies and State-of-the-Art Review for Environmental Health

CE 024 224

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Selected Bibliographies and State-of-the-Art Review for Environmental Health

U.S. Department of Health, Education, and Welfare
Public Health Service
Office of the Assistant Secretary for Health
Office of International Health

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PREFACE TO THE SERIES

The International Health Planning Reference Series has been developed by the Office of International Health, Public Health Service, on request of the Agency for International Development.

The series consists of six basic volumes which cover a variety of health issues considered vital for effective development planning. These volumes contain reports of the state of the art surveys and bibliographies in selected subject areas. These are intended for the serious researcher and planning professionals.

These six volumes are supplemented by ten additional works in the International Health Planning Methods Series, which is intended to assist health sector advisors, administrators and planners in health related activities. Each manual in this series attempts to be both a practical tool and a source book in a specialized area of concern.

The volumes in the International Health Planning Reference Series contain the efforts of experienced professionals who have identified limited but pertinent reference materials for planning in a particular field. These efforts, however, were short term (2 man months) and were mainly prepatory to the writing of the manuals. Through this effort they hope to provide the AID field officers and the host country counterparts with useful references for systematic health planning in developing countries.

PREFACE TO VOLUME TWO

This combined literature review and annotated bibliography deals with the subject of environmental factors in health planning for developing countries. Under this title are grouped concerns for pure water supply, systems for wastewater and excreta disposal, pest control, and similar environmental and sanitation issues. This is the second volume in a series of works known collectively as the International Health Planning Reference Series.

The series was produced by the Office of International Health as requested by the Agency for International Development to provide AID advisors and national health officials in developing countries with critically needed references for incorporating health planning into national plans for economic development.

This volume is intended primarily as a companion piece to volume two in the Methods series, entitled Environmental Health Planning. References included here identify works that support and enlarge upon material contained in the basic manual.

It should be stressed from the outset that the bibliography compiled here makes no claim to be an exhaustive or comprehensive listing of available resources. It is a selective bibliography only. Materials were included only if, in the opinion of the authors, they related directly to environmental problems pertinent to health planning in developing countries.

Texts written in languages other than English were excluded from consideration here. References that were of solely historical interest were not included; nor were several otherwise excellent texts that related only in general terms to our very limited area of interest. Most of the references here are to books or articles published during recent years.

Preparation of this volume was undertaken for the Office of International Health by Plog Research, Inc., of Reseda, California, functioning as a subcontractor to the E.H.White & Co., management consultants of San Francisco, California.

The literature in the field of environmental health is indeed massive. For the purposes of this literature review and bibliography, the research has been focused primarily on the areas of clean water supply, wastewater and excreta disposal, treatment or disposal of solid wastes, and pest control including the use of pesticides.

Additionally, environmental health hazards have been included here to a somewhat lesser extent with reference to occupational health issues, radiation hazards, air quality, food sanitation,and housing issues related to environmental health.

The user of this volume should keep in mind that the literature in this area is also changing and growing at a very rapid rate. Considerable research is in progress, and numerous new reports can be expected to enrich the literature within a short time.

A second important feature of the literature of environmental health is the multidisciplinary nature of much of the research that is taking place. Developments that impact upon environmental issues can be expected to emerge from such fields as microbiology, medicine, epidemiology, public health studies, genetics, and various forms of engineering. A sensitivity to work in progress in these various fields is important to anyone who seeks to remain current on developments in the field of environmental health.

The authors of this literature review and bibliography have frequently expressed personal points of view concerning specific works or projects. While their viewpoints generally coincide with organizations or agencies with whom they are associated, the material in this text should not be construed to reflect the official policy of any agency or organization.

Paul Ahmed

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Each volume in the International Health Planning Reference Series has been the work of many people. In addition to the primary authors, each manual has involved government reviewers and reviewers from positions outside government, editors, revisors, and numerous technical and support personnel. Substantial contributions have been made by manual advisors, who provided the authors with the benefit of their knowledge and experience in the fields under study.

With reference to Volume 2: Environmental Health References, the original authors were Renee White Fraser and Hadasa Shani.

Special thanks are in order for contributions made by advisors John Hanlon and Gary Hart.

Gratitude is also acknowledged to reviewer Vic Wehmann.

While the present work could not have been completed without the assistance of these individuals, responsibility for the content of this manual rests with the authors.

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INTRODUCTION

ENVIRONMENTAL HEALTH PLANNING:

A REVIEW OF THE LITERATURE

Environmental health has been defined by Purdom (1971) as "that aspect of public health that is concerned with those forms of life, substances, forces, and conditions in the surroundings of man that may exert an influence on man's health and well-being."

In this context the environment refers to the totality of external influences - natural, man-made, and humans themselves - which impinge on human beings and affect health or well-being. This broad connotation given to environment reflects the vast literature associated with this field. This report represents a restricted view of this literature, emphasizing that literature most relevant to the environments of developing countries and their related health problems.

Environmental health focuses on the human being. However, along with the rise of the ecology movement, there has emerged a concern for the environment as a whole and for the interrelationships and interdependencies between its components; both living and nonliving. The complexity of the environmental systems and the dynamic nature of their interactions are also affected by social, economic, and political variables.

Issues of current concern intimately associated with environmental health focus on man's impact on the natural environment including fellow human beings. These issues include resource conservation, increasing urbanization, industrialization, population growth, and food supply among others. The more fundamental literature and basic research in environmental health has emphasized the effects of the natural environment on man's health. It is this literature that has been stressed in this review.

This report on the literature addresses known health effects from various pollutants found in the subsystems of environmental health. The ten subsystems of environmental health included are: water quality, wastewater and excreta disposal, solid waste management, pests and pesticides, food sanitation, air quality, occupational health, housing, noise, and radiation. Primary emphasis has been placed on the four subsystems considered most relevant to the developing countries: water quality, wastewater and excreta disposal, solid waste management, and pesticides and pests.

In addition to reviewing health effects and known pollutants, this review considers sanitation methods and environmental control technologies. The technology within these subsystems of environmental health is rapidly developing and reaching high levels of sophistication. Due to the complexity and size of this literature as well as the limited relevance of it to developing countries, this literature has been reviewed selectively and not exhaustively. The literature included represents the most current literature that is relevant to assessment and planning in developing countries. An emphasis has been placed on the inclusion of literature discussing the relevance of particular health hazards from the environment and related control/intervention techniques responsive to the needs of developing countries. This effort has included reviews of research related to urban and rural settings in these countries. It is important to note that the literature is rapidly expanding; to rely solely upon these materials as the most current literature dealing with these subsystems would be an error since the scope of this paper has been limited.

Format

Each of the ten sections devoted to environmental subsystems has a similar format. The depth of coverage and detail within each division of a chapter varies depending upon the relevance of that topic to the environmental subsystem. The extent of background information provided within each chapter varies. This is a function of several factors: the varied amounts of assumed background of the reader, the relevance to developing countries, and the need for useful coverage of the breadth of the subsystem given time and space allowances.

The introductory section of each chapter defines the environmental subsystem, describes the historical development of related research, and identifies the relevance of this subsystem to health in developing countries. The next sections describe the sources of potential health hazards that exist in the subsystem and the processes through which these work. In many cases, the literature discussing assessment of these pollutants, contaminants and/or hazards is also discussed. Additionally, the appropriate preventive, control technologies and interventions as well as the hazards and controversies that surround many of these techniques, have been included in each chapter.

WATER SUPPLY SYSTEMS

A community water supply system has been defined as "an integrated system that delivers safe water, in ample quantity, into the household of every member of the community. It is implied that the provision of this amenity for domestic, industrial, and sanitation purposes is on an uninterrupted basis 24 hours a day and 365 days a year." (Bosch, 1969). This detailed description provides a distinction between the above-defined community systems and intermittent water services, providing poor quality, or delivery. The states of these factors in many developing nations have been described as inadequate by numerous authors (Buck, e al., 1970; Worth and Shah, 1969; Buck, et al., 1972; W.H.O., 1970; American Society of Civil Engineers, 1975; Rajagopolan, 1974; Dieterich and Henderson, 1963).

A WHO survey conducted in 1970 describes the state of water supply systems in certain selected developing countries. Results of that survey indicate "that only 23% of the population had access to safe water. Within urban communities 50% of the population obtained water through individual house connexions, while 23% used public standposts. In rural areas, more than 85% of the population - more than a thousand million people - did not have safe water available to them. Further, in many of the piped urban supplies service was intermittent - a situation that renders a water system potentially hazardous to health. A projection for 1980, allocating a goal of water services to 100% of the urban population (60% by house connexion and 40% by standposts) and to 25% of the rural population required an investment of $13,200 million. The rate of growth of the population is such that, even if the goals are met, there will be 50 million more people in rural areas without safe water in 1980 than in 1970. The increase in population "will result in increased waste production and therefore in greater problems in the disposal of excreta and other wastes." (United Nations Conference on the Human Environment, 1972.)

The status of these countries has been described as similar in many respects to the water supply situation in the United States over 100 years ago (Bosch, 1969). He emphasizes the point that the actual per capital annual costs of the establishment of complete water supply systems is relatively low and that these facilities have been established predominantly through local financing. Further emphasis is placed on the importance of developing water supply systems in the growth of nations; exemplified by the following statement by Abraham Horwitz, Director of the Pan American Health Organization:

"If a single program were chosen which would have the maximum health benefits, which would rapidly stimulate social and economic development, and which would materially improve the standard of living of people, that program would be water supply with provision for water running into or adjacent to the house." (Bosch, 1969)

Historically, the study of water bacteriology came into existence shortly after the development of the germ-disease theory (circa, 1885). It was discovered that waterborne contamination resulted from the pollution of water with sewage containing fecal material, and that feces often carried disease organisms (Chanlett, 1973). In the developing countries today the primary concern for water quality is still its pathogen-carrying capacity (WHO, 1972; WHO, 1970; Dieterich and henderson, 1963).

Sources

The provision of a community water supply system involves an evaluation of the source(s) of water available with respect to its quantity and quality (Salvato, 1972). The most common sources of drinking water are groundwater, from wells and springs, and surface water, from lakes, reservoirs, streams, ponds, swamps, rivers, and creeks (Salvato, 1972). Sea water and atmospheric vapor are potential sources, although to a lesser extent, if properly treated and if sufficient funds are available (Salvato, 1972; Chanlett, 1973; WHO, 1972).

The quantities of available water supply are, of course, critical. Groundwater is most often recommended over surface water due to the fact that groundwater usually requires much less treatment to achieve potability. Groundwater, however, may be less directly available to a population and may therefore require increased technology for its delivery. Typically, a sanitary survey is performed to determine the best source of water, weighing quantity and quality factors as well as economics and the indigenous sociocultural framework (Salvato, 1972; WHO, 1976; Chanlett, 1973).

Quality

The quality of a water source, or its degree of pollution, is, of course, the primary focus with respect to health in any nation. The World Health Organization defines water pollution as "altered in composition or condition so that it becomes less suitable for any or all of the functions and purposes for which it would be suitable in its natural state. This definition includes changes in the physical, chemical and biological properties of water, or such discharges of liquid, gaseous or solid substances into water as will or are likely to create nuisances or render such waters harmful to public health, safety or welfare, or to domestic, commercial, industrial, agricultural, recreational or other legitimate uses of water, or to livestock, wild animals, fish or other aquatic life." (WHO, 1972)

With this definition in mind, water pollution may be produced from the following sources:

- Sewage and other liquid wastes of domestic origin
- Industrial waste
- Agricultural effluents (from animals and irrigation drainage).

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- Urban run-off
- Chemicals such as fertilizers and pesticides used on land or water. (WHO, 1972)

The pollutants produced from each of these sources may contain biological, chemical, and/or physical components that affect the potability of water. The following section will present the potential water pollutants of each type: biological, chemical, and physical.

Biological hazards in water constitute a primary health concern in developing countries (WHO, 1972, WHO, 1970; Pineo and Subrahmanyan, 1975; Dieterich and Henderson, 1963). The biological hazards grouped broadly by type of organism are bacteria, viruses, protozoa, helminths, and algae. There are a variety of means of contact with these organisms, including ingestion of water, personal hygiene, agricultural, industrial, recreational water use, and proximity to water.

Ingestion is a common means of contact with biological pollutants. The accompanying table presents diseases contracted in this fashion.

The most common pathogenic organisms in water are those of enteric origin: the enteric bacteria (e.g., salmonellae and shigellae) and enteroviruses. Another important waterborne virus is hepatitis. Although much is still unknown about the hepatitis organisms, there is a great deal of epidemiological evidence that the disease is transmitted primarily through polluted water (Mosley, 1967; Taylor et al, 1966; Koff, 1970).

The parasitic protozoans and helminths are important waterborne organisms, particularly in developing areas. Amoebiasis is widespread throughout the warm countries of the world that have poor water sanitation (WHO Expert Committee on Amoebiasis, 1969). Dracontiasis, caused by the guinea worm, is another common disease which is often transmitted through open infested village wells and ponds (WHO, 1972). The intestinal helminths of primary health significance are Ascaris lumbricoides and Trichuris trichiura (WHO, 1972). Both are transmitted primarily through soil contact although secondarily through water contact. It has been established that, as of 1967, one fourth of the world's population was infested with ascariasis (WHO Expert Committee on the Control of Ascariasis, 1967).

Biological hazards associated with water may also be contacted by the body directly. This is most significant in developing areas where water supply may be used for a variety of purposes simultaneously (e.g., bathing, laundry, recreation, urination, excreta disposal) as well as for drinking. Schistosomiasis is an international disease problem of significance in the developing nations which is typically contracted through body contact with water; the trematodes entering the body through the feet (WHO, 1972). The World Health Organization estimated, in 1967, that the prevalence of schistosomiasis in certain endemic areas was greater than 50 percent. More recent estimates abound for individual countries (WHO, 197[illegible]; Kamal, 1972; Andreano, 1976; Ayad, 1974). Other parasitic diseases contacted in a similar manner include ancylostomiasis and strongylostomiasis (WHO, 1972).

Vectorborne diseases typically associated with water include malaria, onchocerciasis (river blindness), yellow fever, trypanosomiasis, and filariasis. All of the above predominate in the developing countries (Pineo and Subrahmanyam, 1975; WHO Expert Committee on Filariasis, 1976; WHO Expert Committee on Yellow Fever, 1971; WHO Expert Committee on Malaria, 1966; WHO Expert Committee on Trypanosomiasis).

Numerous studies have been performed in an attempt to establish a relationship between community water supply availability (quantity and accessibility), quality of water, and sanitary excreta disposal on the one hand and the incidence

Table 1

Waterborne Diseases Transmitted by Ingestion

Grouped by types of etiological agent and
ranked by likelihood of transmission

Disease	Agent	Comment
	Bacterial agents	
1 Cholera	*Vibrio cholerae*	Initial wave of epidemic cholera is waterborne. Secondary cases and endemic cases are by contact, food, and flies.
2 Typhoid fever	Salmonella typhi	Principal vehicles are water and food. Case distribution of waterborne outbreaks has a defined pattern in time and place.
3 Bacillary dysentery (Shigellosis)	*Shigella dysenteriae* *Shigella flexneri* *Shigella boydii* *Shigella sonnei*	Fecal-oral transmission with water one transmitter. Direct contact, milk, food, and flies are other transmitters. Ample water for cleanliness facilitates prevention.
4 Paratyphoid fever	*Salmonella paratyphi* *Salmonella schottmulleri* *Salmonella hirschfeldi*	Few outbreaks are waterborne. Other fecal-oral short circuits dominate. Ample water facilitates cleanliness.
5 Tularemia	*Pasteurella tularensis*	Overwhelmingly by handling infected animals and arthropod bites. Drinking contaminated raw water infects man.
	Protozoan agent	
1 Amebic dysentery (amebiasis)	*Entamoeba histolytica*	Epidemics, which are rare, are mainly waterborne. Endemic cases are by personal contact, food, and possibly flies.
	Viral agent	
1 Infectious Hepatitis	A filterable virus, not isolated	Epidemics are due to transmission by water, milk, and food, including oysters and clams.
	Helminthic agent	
1 Guinea worm disease (dracontiasis)	The roundworm, *Dracunculus medinensis*; gravid female, 1 m long, migrates to skin	Unknown in North America. Cycle is worm larva through human skin to water to the crustacea, such as cyclops, to man's ingestion of water with cyclops in infective form.

of waterborne and water-related diseases on the other. The results of many of these have been summarized in a WHO document (Pineo and Subramanyam, 1975):

"In summary, all the studies can be said to show that better water and improved sanitation lead to better health. Many of the studies show that the incidence rates of diarrhoeal diseases are much lower when water supplies and excreta disposal facilities are available inside the house. The bacteriological quality of water plays an important role in the control of diseases in whose transmission water is a major pathway (e.g., cholera, typhoid). Other studies show that improvement of water supplies alone without concomitant provision of sanitary disposal of excreta is much less effective. It can also be stated that, for development, community water supplies and sewage disposal are essential but not sufficient in themselves. Development in the health services sector and in other sectors such as agriculture and communications is also vital."

Nonpathogenic waterborne organisms may affect water quality by creating a nuisance; rendering the water unpalatable or clogging pipes of filtration mechanisms. Common organisms in this group include actinomycetes, algae, crustaceans (e.g., cladocera, copepods, and isopods), fecal streptococci, coliform bacteria, iron bacteria, rotifera, and certain free-living worms (Chanlett, 1973).

Exclusive outlines of the biological hazards in water are described in a number of texts (Salvato, 1972; Chanlett, 1973; Purdom, 1971; Surveillance of Drinking Water Quality, 1976; International Standards for Drinking Water Quality, 1971; European Standards for Drinking Water, 1970; Higgins and Burns, 1975).

Chemical hazards typically encountered in water may affect human health, esthetic acceptability of water, or the balance of the aquatic ecosystem. Only a brief evaluation of all chemical substances, both naturally occurring and synthetic, is discussed here. For a more extensive description the reader is directed to the following sources: Salvato, 1972; American Chemical Society, 1969; Chanlett, 1973; Burdom, 1971; WHO Surveillance of Drinking Water Quality, 1976; International Standards for Drinking Water, 1971; European Standards for Drinking Water, 1970; Sawyer and McCarty, 1967; Higgins and Burns, 1975; Pollution Abstracts. Nitrates, fluorides, arsenic, selenium, mercury, lead, and cadmium will be discussed in this section, with speculations on their contributions to health and disease through the water medium.

Nitrate concentrations are of primary significance in well waters as opposed to surface waters. The World Health Organization and the U. S. Public Health Service recommend that levels of nitrate should not exceed 45 mg/l (WHO, 1971). The concern with high nitrate concentrations is that they may cause the development of methemaglobinemia in babies (Taylor, 1975; Gruener and Shuval, 1972, 1974)

Fluorides occur naturally in many water systems, providing protection in children against dental caries when exposed to a minimal concentration (McClure, 1970; Prasad, 1976; Horvath, 1976; Underwood, 1971; Hodge and Smith, 1970; Toth, 1975). At high concentrations fluroide may contribute to mottling of tooth enamel (Adler, et al., 1970). The concentration minimum and maximum (in the range of 1 ppm) vary with temperature and age of the individual (Toth, 1975). A review of other health-related effects of fluoride have been provided by Navia, et al. (1976).

Arsenic has been recognized as toxic to human beings for centuries (WHO, 1972). High concentrations have been reported in drinking water supplies in Latin America and the Western Pacific, and have been associated with endemic arsenic poisoning (Astolfi, 1971; Bruning, 1971) and "blackfoot" disease (I-Cheng Chi' and Blackwell, 1968). These associations are, at present, in controversy (Valentine, 1977).

Selenium is another trace element found in varying concentrations in water usually reflecting the concentrations in the soil of that area. The degree of exposure from water is insignificant compared to exposure from food, and no toxicity from water has been established (Underwood, 1971; Horvath, 1976).

Mercury is a toxic metal, especially when converted to organic forms such as methylmercury (Prasad, 1976). It may be present in this form in both marine and fresh water organisms such as fishes and shellfish (Horvath, 1976). The levels in water are mainly significant as they bioaccumulate in animals.

Another important element in water is lead, the concentrations of which increase significantly through the use of lead pipes or plastic pipes with lead stabilizers (WHO, 1972; Horvath, 1976). Exposure is greatest, however, from air (Horvath, 1976). Effects on health include damage to the neural, hematopoietic, and renal systems (Horvath, 1976; Prasad, 1976; Goldberg and Silbergeld, 1974).

Cadmium is toxic to animals and although the specific contribution of levels in water has not been determined, low level exposures, such as those typically found in water, can be detrimental to health (Horvath, 1976). Epidemiological studies have linked chronic cadmium exposures with hypertension in humans (Underwood, 1971; Perry, 1974; Masironi, 1972).

There are numerous organic compounds found in water. These include the pesticides (herbicides, insecticides, rodenticides, molluscicides, and fungicides) to be discussed in a later section, and a wide variety of industrially produced organics, many with reported carcinogenic properties (WHO, 1972).

Recommended levels for many chemical pollutants are proposed by the World Health Organization (1971). The significance of chemical quality to the developed world is well documented (American Chemical Society, 1969; Salvato, 1971; Chanlett, 1973; Purdom, 1971). However, significance for the developing countries is not well established.

Physical quality factors present in water include taste, turbidity, color, temperature, and odors. The causes of these factors may be biological and/or chemical as well as physiographic. Concern with physical quality results from its utility as a general indicator of potential health hazards as well as its indication of the inadequacy of a water supply with respect to esthetics and general potability. Recommended levels for physical quality factors are provided by the World Health Organization (1971).

Sampling Methods

Methods of sampling of a water system for levels of pollutants are described extensively in the literature for biological, chemical, and physical quality factors (American Public Health Association, 1975; Salvato, 1972; WHO, 1976; Sawyer and McCarty, 1967; McKinney, 1962). The most basic microbiological examination of water involved the detection of the indicator organism, Escherichia coli, by either the M.P.N. test (Most Probable Number), or the millipore filtration technique (Salvato, 1972; American Public Health Association, 1975).

Sampling for chemical quality in a developed community most typically involves tests for T.D.S. (Total Dissolved Solids), B.O.D. (Biochemical Oxygen Demand). chlorides, alkalinity, hardness, sulfate, and phosphate (American

Public Health Association, 1975; WHO, 1976; Chanlett, 1973; Salvato, 1972; Purdom, 1971; Sawyer and McCarty, 1967; American Chemical Society, 1969).

Physical sampling involves a turbidity test, color measurement against standards, temperature, pH, and odor and taste examinations measured by individual sensory responses (WHO, 1976; WHO, 1971; American Public Health Association, 1975; Chanlett, 1973; Salvato, 1972; Purdom, 1971).

It has been recommended that a minimal sampling procedure for waters should include a determination of coliform levels, especially for surface waters, and an approximation of turbidity (WHO, 1971; WHO, 1972).

Intervention Techniques

The source and protection of a water supply are considerations in both rural and urban areas. Groundwater sources are often preferred since they require less treatment, and supplies include dug, bored, driven, and drilled wells, rock and sand or earth springs, and infiltration galleries. These have been described extensively (Salvato, 1972; Fair, et al., 1966; Bennison, 1947).

Technologies have been developed for rural delivery and protection, including well digging and simple hand pumps (World Council of Churches, 1973; Watt, 1976; Spangler, 1975; Fannon, 1975; Gibson and Singer, 1969; Wagner and Lanoix, 1959; Watt, 1974; Kindel, 1975; Rife Hydraulic Manufacturing Col, 1975; Bateman, 1974) and piping (A. T. Unit Report #5, Majunder, 1967; Spangler, 1975).

Treatment of water for the least technologically advanced community may involve simply chlorination to kill pathogens and slow sand filtration to remove suspended materials while groundwater may not require treatment at all (WHO, 1972). Applications of these methods for rural communities have been established (Mann and Williamson, 1973; Huisman and Wood, 1974; Bateman, 1974).

Treatment of surface waters in more advanced communities consists of flocculation, sedimentation, rapid or slow sand filtration, and chlorination while groundwater may simply require chlorination (Salvato, 1972). Methods of treatment for the removal of individual biological and chemical pollutants have been extensively investigated. These methods are relative sophisticated and are rapidly changing with technological advancement.

WASTEWATER AND EXCRETA DISPOSAL

The disposal of excretory materials has been a significant concern for humankind throughout history. Most typically, either water or land were used to dispose of feces. Streams have been a primary disposal medium, possessing self-purification properties capable of decomposing and dispersing organic materials. However, the increasing load of organics corresponding to increasing populations have overloaded the natural cleansing mechanism. Soil as a disposal medium also provides certain benefits. Feces will dry and decompose in the soil, thus replenishing certain basic nutrients needed for plant cultivation. This natural process, however, has become impractical with population growth since deposition must, of necessity, occur in close proximity to human settlements, thus attracting rodent and insect pests.

Historically, a few ancient cities (e.g., Assyria, Babylon) developed sanitation laws, outlawing the disposal of organic residues into rivers (Higgings and Burns, 1975). Most other cultures, however, did not exhibit this concern (Higgins and Burns, 1975).

The primary health significance associated with excretory materials comes from its potential for harboring pathogens, particularly the enteric organisms (Peel, 1967; Cooper, 1974). Studies of environmental health in certain rural areas (Worth and Shah, 1969; Buck, et al., 1970; Buck, et al., 1972, Sofoluwe, 1973; WHO, 1972) indicate a high prevalence of indiscriminate feces deposition on land with no attempt made at covering or decontamination. In a few of the cases studied where latrines or pit privies do exist, the frequency of their use is very low, and most are unsanitarily maintained. Insects and rodents have been reported in close proximity to these latrines, and overflow from improperly constructed facilites often leads to contamination of the water supply. Also reported is the use of the water supply for laundry and bathing and the common occurrence of domestic and wild animal defecation in the water.

Biological Hazards

Deposition of excretory material on land presents a number of potential hazards such as direct contact with the feet, attraction of pests and vectors to the area, transmission to food crops, and a potential source of contact for children and domestic animals (WHO, 1972). Certain intestinal parasites are most typically contracted by stepping on dried feces. Ascariasis (WHO, 1967) and ancylostomiasis (hookworm) are contacted in this manner. Other diseases of fecal origin that may be contracted from soil include cholera, salmonellosis, bacillary dysentery, typhoid, paratyphoid, and amoebiasis (WHO, 1972).

The attraction of pests and vectors to feces is examplified in the attraction of flies to fecal material. Flies have been found to harbor numerous disease organisms in their systems that may infect humans (Chanlett, 1973). Food may serve as an intermediary medium for the transmission of certain enteric diseases (WHO, 1972).

Helminths (worms) appear to be a significant biological hazard associated with fecal contact in developing nations (WHO, 1972; WHO, 1967; Wagner and Lanoix, 1958). The following statement by Van Zile Hyde in 1951 emphasizes this point, stating: "The worms infesting the people of a certain semi-tropical country metabolize more of the produce of that country than do the inhabitants. Half the work of a sick peasantry, therefore, goes into the cultivation of food for the worms that make them sick." (Cited from Wagner and Lanoix, 1958). The significance of this statement endures although the percentage of infested citizens may have changed.

The biological hazards associated with wastewater are primarily the infectious agents; bacteria, viruses, and parasites (Cooper, 1974). These organisms are addressed more specifically in the section dealing with water quality.

Chemical Hazards

Chemical pollutants contained in feces may be deposited on the soil or may enter the water system. A variety of toxic substances previously ingested may follow this route. The levels of these chemicals may be concentrated in food crops through the use of feces as fertilizer or the reuse of wastewater for irrigation.

The organic materials found in wastewater have been found to stimulate the growth of microbial populations which, in turn, utilize the available dissolved oxygen in the water (American Chemical Society, 1969; Salvato, 1972; Higgins and Burns, 1975). Depletion of sufficient quantities of dissolved oxygen, accompanied by high levels of organics, eventually lead to conditions of eutrophication in certain aquatic systems (Reid and Wood, 1976). The organics typically contained in wastewater include lipids, amino acids, hemicellulose, cellulose, lignin, protein, and ash (Higgins and Burns, 1975).

Control Techniques

Given the necessity for sanitary disposal of excreta, the following requirements have been described by Chanlett (1973) for an adequate system:

"(1) The surface soil should not be contaminated.
(2) There should be no contamination of ground water that may enter springs or wells.
(3) There should be no contamination of surface water.
(4) Excreta should not be accessible to flies or animals.
(5) There should be no handling of fresh excreta; or, when this is indispensable, it should be kept to a strict minimum.
(6) There should be freedom from odors or unsightly conditions.
(7) The method used should be simple and inexpensive in construction and operation."

Sanitary disposal of excreta is generally accomplished by infiltration techniques such as pit latrines or aqua privies; by manual or mechanical removal methods using buckets, vacuum units, or sewage pipe networks; by destruction (incinerating toilets); or by decomposition as in compost privies or methane digesters (McGill University, 1973). For most rural communities, composting privies have been highly recommended (Farallones Institute, 1974). In a recent review of excreta disposal techniques by McGill University (1973), the following statement is made:

"It should be clear, at this point, that water-borne waste represents a (relatively recent) answer within a particular set of economic and physical conditions, and not clearly the least wasteful answer at that. Flush toilets should not be considered as 'advanced' compared to the pit latrine. Under certain conditions the latter is ecologically sound, cheap and quite safe."

The pit privy is claimed to be most effective in meeting the needs of excreta disposal by keeping it out of the water supply, off the ground surface, and inaccessible to animals, especially disease vectors (Salvato, 1972). One author claims:

> "Indeed, it is paradoxical that the sanitary pit privy provides more certain containment of the pathogens of cholera, salmonellosis, shigellosis, typhoid and paratyphoid fevers, amebiasis, schistosomiasis, hookworm, ascariasis, trichuriasis and infectious hepatitis than the sewage systems of cities, large and small, with and without sewage treatment facilities." (Chanlett, 1973)

The chief advantages of the pit privy for developing countries are that it is inexpensive to build, may be used in any part of the world, and may be constructed by a family with little or no outside help (Wagner and Lanoix, 1958). Its role in the prevention of disease makes it a very useful and fundamental control method (Wagner and Lanoix, 1958).

Studies of the degree of flow of Escherichia coli from pit-type privies incidate that in those that do not contact groundwater, typical of most privies is this type, E. coli never reached further than 5 feet from the pit. In those privies that did penetrate to the groundwater, migrations did not exceed 35 feet (Chanlett, 1973).

The aqua privy is a modification of the pit privy. It is as effective as the pit privy although it is more expensive, requires water for operation, and requires maintenance (Wagner and Lanoix, 1958). In addition, it has the disadvantage of not being functional in cold climate.

Construction methodologies and specification for the selection of the pit privy, aqua privy, and others, have been provided by Wagner and Lanoix (1958) and Salvato (1972).

Chanlett (1973) describes the history of modern water-carriage methods of excreta disposal, or sewage disposal, as beginning in 1596 with the invention of the first modern valve water closet. He claims that popular acceptance of this technique did not occur until the 1800's in Europe and the United States. These early systems discharged to cesspools, while later systems combined liquid wastes from both human waste waters and all other liquid wastes into a common sewerage system. Chanlett (1973) reports that with urban communities increasing in size and numbers, the primary target for control of communicable diseases of fecal origin changes from management of excreta disposal to protection of the water and food supply from contamination.

Domestic sewage is composed not only of fecal material but also of wastes from personal and household cleaning and food by-products. These substances increase the total organic and inorganic load of the water and, especially in the case of organics, may provide foodstuff for a wide variety of nuisance organisms. Treatment of sewage becomes necessary before discharge into receiving streams.

The advantages and disadvantages of water-carriage sewage disposal have been provided by Wagner and Lanoix (1985): "Experience has shown that, when running water is available, the water-carried system of excreta collection and disposal is most satisfactory and convenient under both urban and rural conditions. It fulfils all sanitary and aesthetic criteria. In particular, contamination of the soil and of surface water is avoided; potentially dangerous wastes are rendered inaccessible to flies, rodents, and domestic animals; and the mechanical transmission of faecal-borne diseases to man is prevented.

"One serious disadvantage, however, is the difficulty of disposing of the large volume of wastes resulting from the addition of water. While in cities the liquid wastes are usually carried away by means of sewers, in most rural areas of the world sewerage systems do not exist, and liquid wastes are conveniently discharged into the ground. Since in such areas ground water is often tapped as a source of domestic water-supply, there is an obvious need for proper location and construction of the excreta disposal system, with a full understanding of the hazards involved."

The sewage treatment process is designed to repeat the natural self-purification occurring in streams: settling, anaerobic decomposition of solids, and bio-oxidation of nonsettleable and dissolved organic material (American Chemical Society, 1969). These processes are accelerated, controlled, and supplemented and a purified effluent is produced.

Standard sampling techniques for monitoring these levels include the B.O.D. (Biochemical Oxygen Demand), suspended solids, and bacterial count examinations (APHA, 1975).

Wagner and Lanoix (1958) describe the alternative methods of liquid waste disposal most relevant to rural areas. These include disposal into large bodies of water for dilution, the use of cesspools and seepage pits, and the septic tank systems which involve irrigation fields, filter branches, or sand or trickling filters. Factors affecting the selection of a particular system include the degree of sewage treatment to be provided, the location of the system, costs, and various local factors such as topography, soil type, the presence, level, and direction of flow of groundwater, the quantity of sewage, the proximity of water supply sources, and the area available for the disposal system (Wagner and Lanoix, 1958). The advantages and disadvantages of the above disposal methods have been described extensively in the literature (Salvato, 1972; Wagner and Lanoix, 1958; American Chemical Society, 1969; Gloyna, 1971; Rajagopalan and Shiffman, 1974; Jaag, 1969).

Systems of sewage treatment for disposal at private homes in rural areas consist of a septic tank for settling and treatment. This includes a subsurface leaching system for the disposal of overflow, provided the soil is satisfactory (Salvato, 1972; Wagner and Lanoix, 1958). Critical factors to be considered in the establishment of such a septic tank system include soil permeability, volume of waste to be disposed, and cost.

In areas with sufficient available land, oxidation ponds or waste stabilization ponds are recommended as a relatively inexpensive method of treatment. (Shipman, 1976; Salvato, 1972; Jaag, 1969; Stander and Meiring, 1965; Gloyna, 1971). The principles involved in these ponds are described as follows:

"In waste stabilization ponds the decomposable organic wastes are stabilized by micro-organisms and the numbers of disease-causing agents are reduced significantly, primarily due to the long detention period required for stabilization. In some types of pond, aerobic conditions can be maintained by the natural photosynthetic processes of algae. These green plants provide most of the oxygen required for aerobic stabilization. The remainder of the oxygen is transferred from the air to the water by natural surface mixing processes." (Gloyna, 1971)

One proposed system involves the use of aqua privies (with retention tanks) and transferral of the wastewater to the oxidation pond for treatment. (Salvato, 1972; Joag, 1969; WHO, 1966)

Basic sewage treatment methods of use in many developed nations are composed of two stages: primary treatment including grit removal, screening, grinding, flocculation and sedimentation (Fischer, 1976); and secondary treatment or biological oxidation using either the trickling filter technique, activated sludge, or waste stabilization ponds. (American Chemical Society, 1969; Salvato, 1972; Chanlett, 1973; Purdom, 1971; Fair, et al., 1968) The degree of success of these methods is evaluated by the extent to which pathogens, suspended solids, and other oxygen-demanding materials are removed. (Gloyna, 1971; Rudolfs, et al, 1950; American Chemical Society, 1969; Purdom, 1971).

Sewage treatment processes often include a variety of methods for the selective removal of particular biological or chemical pollutants. For example, viruses are not removed by standard sewage treatment, but it has been found (Berg, 1974) that such techniques as coagulation with metal ions, adjustment of pH, the addition of polyelectrolytes, and other procedures may prove to be viricidal under certain conditions. These procedures may, however, produce harmful effects on aquatic life (Berg, 1974).

The wastewater disposal system is intimately associated with both the water and solid waste systems. A key issue in environmental health today is the disposal of effluent and sludge solids after treatment. Many researchers are proposing the integration of these systems such as integrated liquid and solid wastes management (Sumner, 1969; Gilbertson, 1969) and the reuse of effluent for agricultural and industrial purposes (Karlen, 1976; Huval, 1969). Composting with "night soil" (combined urine and feces) has been extensively investigated by the Chinese (Anon., 1975; Scott, 1952).

Many advanced techniques for the reuse of wastewater are being investigated. Biological purification of wastewaters is a primary focus (Tourbier and Pierson, 1976; McHarg, 1976; Goldman and Ryther, 1976). Cultivation of algae in wastewaters is one method of biological control (Goldman and Ryther, 1976; Carpenter, et al, 1976; Trieff, et al, 1976; John, et al, 1976). Integrated biological wastewater treatment systems are being evaluated (Dinges, 1976). One interesting system (Wolverton, et al, 1976) involves the cultivation of aquatic vascular plants to take up nutrients such as nitrogen, phosphorus, phenols and trace metals. The plants (e.g., water hyacinths and alligator weeds) may then be used as fuel or animal feed. It has been found (Seidel, 1976) that certain species of aquatic plants kill disease bacteria in sewage as well as metabolize polluting substances. One investigator (DeJong, 1976) reports that sewage treatment with rush ponds is considerably less expensive than the activated sludge treatment procedure.

The disposal and/or reclamation of sludge are critical concerns in environmental health. Typical methods of disposal include lagooning, landfilling, land application, ocean disposal, and use as compost and fertilizer (Gehrm, 1976). The issue of ocean disposal is currently in controversy in the developed countries (Lehman, 1974) due to findings that large volumes of sludge are altering the marine ecological balance and that toxic pollutants are accumulating in marine organisms. Extensive research is in progress concerning this issue (Lehman, 1974).

SOLID WASTES

Solid wastes, their hazards and management are a critical issue in urban and rural areas of both developed and developing nations. Increasing populations, industrialization, and consumerism contribute to the production of more and more waste and the problem of its storage and disposal. Unlike the management of water, wastewater, and air quality, the research and technology in solid waste management has been lacking and inadequate (WHO, 1972; Chanlett, 1973).

Solid wastes have been defined as "all non-gaseous, non-liquid wastes resulting from the wide range of community, industrial, commercial, and agricultural activities." (Gilbertson, 1969). Refuse and solid waste are often used interchangeably. Other classifications of wastes are listed in the following table with the compositions and sources of each.

TABLE 2 REFUSE MATERIALS BY KIND, COMPOSITION, AND SOURCES

Kind	Composition	Sources
Garbage	Wastes from preparation, cooking, and service of food; market wastes; wastes from handling, storage, and sale of produce.	Households, restaurants, institutions, stores, markets
Rubbish	Combustible: paper, cartons, boxes, barrels, wood, excelsior, tree branches, yard trimmings, wood furniture, bedding, dunnage. Noncombustible: metals, tin cans, metal furniture, dirt, glass, crockery, minerals.	Same as garbage.
Ashes	Residue from fires used for cooking and heating and from on-site incineration.	Same as garbage.
Street refuse	Sweepings, dirt, leaves, catch-basic dirt, contents of litter receptacles.	Streets, sidewalks, alleys, vacant lots.
Dead animals	Cats, dogs, horses, cows.	Same as street refuse.
Abandoned vehicles	Unwanted cars and trucks left on public property.	Same as street refuse.
Industrial wastes	Food-processing wastes, boiler-house cinders, lumber scraps, metal scraps, shavings.	Factories, power plants.
Demolition wastes	Lumber, pipes, brick, masonry, and other construction materials from razed buildings and other structures	Demolition sites to be used for new buildings, renewal projects, expressways
Construction wastes	Scrap lumber, pipe, other construction materials.	New construction, remodeling
Special wastes	Hazardous solids and liquids: explosives, pathological wastes, radio-active materials	Households, hotels, hospitals, institutions, stores, industry.
Sewage treatment residue	Solids from coarse screening and from grit chambers; septic-tank sludge.	Sewage treatment plants, septic tanks.

The scope of the problem of solid waste management has been described in a paper by Ellis (1969). He points out that the continually increasing world population is causing an increase in the quantities of waste being produced and that the weight and volume of that refuse are increasing with prosperity. The quality of wastes is changing due to such factors as the use of gas, oil, or electricity, rather than coal and wood for energy and the increasing use of packaging materials of all types (Chanlett, 1973). In direct opposition to the increases in production of solid waste is a decrease in the availability of land for its disposal. As the urban centers increase in size, the refuse must be transported for greater distances to the disposal areas, thus increasing the costs. A lack of public awareness and support have been proposed as contributory to difficulties in obtaining land for disposal sites (WHO, 1967).

Health Consequences

Direct correlations between health problems and solid waste handling are scarce (Chanlett, 1973; Purdom, 1971, American Chemical Society, 1969; Gilbertson, 1969). The following statement by T. G. Hawks (Chanlett, 1973) describes the solid waste/disease relationship:

"The literature fails to supply data which would permit a quantitative estimate of any solid waste/disease relationship. The circumstantial and epidemiologic information presented does support a conclusion that, to some diseases, solid wastes bear a definite, if not well defined, etiologic relationship. The diseases so implicated are infectious in nature; no relationship can be substantiated for noncommunicable disease agents associated with solid wastes, not because of negating data, but because of lack of data. (An exception to this statement may exist in the instance of methemoglobinemia of infants in which nitrates of excretory origin may play a part.)

"The communicable diseases most incriminated are those whose agents are found in fecal wastes—particularly human fecal wastes. Where these wastes are not disposed of in a sanitary manner, the morbidity and mortality rates from fecal-borne diseases in the population are high. Despite the fact that other factors are known to contribute to some reduction of these rates, the inescapable conclusion is that the continued presence in the environment of the wastes themselves is the basic causative factor. Therefore transmission—whether by direct contact, vector transfer, or indirect contact—is due to environmental contamination by these wastes."

It is generally accepted that mismanagement of solid wastes will lead to water pollution, air pollution, and soil pollution (Heidman and Brunner, 1976; Needle and Garland, 1975; Sumner, 1969; American Chemical Society, 1969; Gilbertson, 1969). An example of this is the case of runoff from dumps that may carry pollutants into a water source located in close proximity (Carnes, 1976). Open and indiscriminate dumping will pollute the soil and burning of solid wastes in an uncontrolled manner will increase the levels of particulates, aldehydes, and benzo-(α)-pyrene in the air (Chanlett, 1973; Heidman and Brunner, 1976; Needle and Garland, 1975).

It has been assumed that since solid wastes attract such organisms as rats, flies, roaches, and other disease carriers, that a health hazard exists from exposure to mishandled solid wastes (Chanlett, 1973; American Chemical Society, 1969).

An estimate of the amount of solid waste produced per person was provided for 1950 in the U. S. as 3.3-4.0 pounds (or 1.5-1.8 kg) per capita per calendar day (Gilbertson, 1969). Within less than 20 years from that time, the estimate increased to an average of 5.4 pounds (2 kg) per capita per calendar day in the U. S. (Gilbertson, 1969).

The character of solid waste has been described by Ellis (1969) as variable in density, moisture content, thermal values and combustible and compostable content. These characteristics may be affected by such variables as seasonal changes, the type of collection system, the standard of living of the population, the extent and type of commerce and industry, and the prevailing climate (Salvato, 1972). All of the above factors participate in the complex system of solid waste management. Additional factors that affect the system and may cause special problems are oversized wastes, such as waste lumber, trees, stumps, and furniture, and plastics and other synthetic substances. PVC (polyvinyl chloride) is a synthetic polymer that has many health implications. It has been associated with angiocarcoma of the liver in manufacturing workers (Tabershaw and Gaffey, 1974), and has been found to be destructive to waste disposal mechanisms and to human health in its disposal (Ellis, 1969; Gilbertson, 1969).

Solid Waste Management

The technology of solid wastes management has been separated into the following categories: storage, collection, and disposal (Gilbertson, 1969). Storage of solid wastes is critical for individual residences awaiting either collection or disposal. Open storage of refuse, commonly reported in certain rural communities of developing nations (Buck, et al, 1972), is well known to attract pests, particularly rodents anf flies, to the area. Collection of refuse poses a significant problem in the developed countries due to the expense of widespread collection programs and their relative inefficiencies (Salvato, 1972). Disposal of solid wastes involves some method of treatment or conversion followed by reuse or disposal (Gilbertson, 1969). The disposal methods generally accepted in the field include hog feeding, incineration, open dumping, ocean dumping, grinding and adding to sewage, sanitary landfill, composting, and salvage (Chanlett, 1973). The advantages and disadvantages of these procedures have been elaborated by Chanlett (1973) in the following table.

TABLE 3

FIRST-STAGE DISPOSAL METHODS OF SOLID WASTES

Methods	Advantages	Disadvantages
Hog feeding	Revenue from contract or from hog sale. Salvage and conservation	Trichinosis transmission. Fly and rat feeding and breeding. Separate disposal of rubbish. Necessity of supervising contractor. Hog diseases must be controlled.
Incineration	Combustion of breeding materials. Takes combined garbage and rubbish. Can be very efficient and run 24h day in large cities.	Final ash residue, cans, and bottles remain. High capital investment. High operational and maintenance cost. Particulates and odors from poor operation. Often requires addition of combustibles.
Open dumps	Hauling is only cost. Combined collection.	Optimum for rat and fly breeding. Neighborhood depreciation. Mosquito breeding. Air pollution from dump flies. Water pollution from leaching.
Dumping at sea	Combined collection	Cost of tugs, barges, and operation. Float back to beaches and shores. Possible toxicity to fish and flora.
Grinding and adding to sewage	Gives garbage same handling as excreta. For home units, collection phase of food wastes is eliminated.	Takes only garbage. Requires proper sewer design if home units are used. Requires added sewage plant facilities for central grinding and treatment. Rats appear in sewers. Digest solids must be handled.
Sanitary landfill	Combined collection. Low capital investment. Moderate operational cost. Land reclamation for restricted use. Adapted to small towns.	Land requirement may result in long hauls in the future. Requires selected soil for cover. Requires standby fire control. Leaching adds pollutants to ground and surface-water sources.
Composting	Conserves and recycles wastes. Provides humus for soil. Decomposition heat controls flies. Aerobic action free of odors. Sewage sludge can be combined.	Requires presorting and grinding and turning. High capital equipment and maintenance cost. Requires assured market for compost. Requires disposal of noncompostables. Requires carbon: nitrogen ratio of about 30:1.
Salvage	Recovery of usable and salable material. Conservation of resources. Defrays cost of waste handling.	Limited to special wastes and selected materials. At mercy of market.

The three techniques generally recognized as most effective for large scale solid waste disposal are incineration, composting, and the sanitary landfill (Salvato, 1972; Chanlett, 1973; American Chemical Society, 1969). The comparative costs and benefits of the three methods are discussed by Gilbertson (1969). He states that the sanitary landfill is the least expensive if land is readily available and reasonably priced. He further describes the benefits of the sanitary landfill as requiring no secondary disposal once the site has been filled, that size and moisture content of the wastes need not be regulated, and that the landfill site may be reclaimed for recreational use once it has been filled. In comparison, composting and incineration are more costly and require size and moisture regulation of the waste materials (Gilbertson, 1969). The primary benefit of composting is the recycling of organic materials as possible fertilizer (Meyer, 1972) and the primary benefit of the incinerator is that it requires very little land (Gilbertson, 1969).

Composting has been extensively investigated, particularly in the Orient, for its ability to dispose of solid waste materials and excretory materials and to convert them to a reusable form (Gotaas, et al, 1953; Meyer, 1972; Anonymous, 1975). The specific techniques and technologies for composting are described extensively in the literature (Salvato, 1972; American Chemical Society, 1969; Gotaas, et al, 1953; McGauhey and Goleuke, 1953; Krige, 1955).

The question of applicability of western technology to developing countries is of concern in solid waste disposal and all subsystems of environmental health. Flintoff (1976) suggests that certain global differences influence the adaptability of solid wastes management technology. These are: quality and quantity of waste, economics, climate, technical resources, social and religious constraints, and urban character. Flintoff (1976) identifies certain technologies as being generally adaptable to specific areas, such as the sanitary landfill in arid regions and the European manual street sweeping methods and equipment for many developing areas.

Reuse of Solid Wastes

Currently a great deal of research is being performed on alternative methods for reuse of solid wastes, particularly for the production of food (Rolfe, 1976; Birch, et al, 1976; Tannenbaum and Pace, 1976; Imrie and Righelato, 1976). Recovery of proteins may be accomplished directly from industrial wastes of the meat, dairy, and vegetable processing industries (Birch, et al, 1976) or by culturing algae and fungi on waste materials (Birch, et al, 1976: Rolfe, 1976; Irmrie and Righelato, 1976). Rolfe (1976) discussed the issue of food from waste materials within the framework of the current world situation. He describes the processes of protein production by microorganisms and discusses some of the treatment procedures required to render these proteins edible by human beings. Rolfe (1976) further posits that implementation of these recycling systems will be most difficult where they are most needed, in the developing countries.

Waste materials may be recovered as sources of energy (Payne, 1976). These techniques are most relevant to the developed countries in particular. Payne (1976) provides a discussion of the currently accepted technologies for energy generation; converting refuse to steam, solid fuel, liquid fuel, gaseous fuel, and electricity.

PESTICIDES, PESTS, AND PEST CONTROL

Pesticides

A definition of a pesticide has been provided by Aldrich and Gooding (1976), as "any chemical or biological agent that is capable of killing or limiting the undesired effects of any living organism." Beyond this definition, pesticides are typically classified functionally as insecticides, rodenticides, nematocides, fungicides, molluscacides, and herbicides, (American Chemical Society, 1969). The dichotomous nature of these substances (e.g., insecticides) as both ecological poisons and lifesavers against certain insect-borne diseases has perpetuated an ongoing controversy over their utility (Aldrich and Gooding, 1976; Higgins and Burns, 1975; WHO, 1972).

One of the earliest users of a pesticide cited in history (Aldrich and Gooding, 1976) was Marco Polo, who introduced pyrethrum in Europe as an insecticide. Earlier evidence indicates the use of sabadilla extract by certain South American peoples as a lice killer. Other early pesticides include nicotine, first used in 1763 to control aphids, and Paris green, or cupric acetoarsenite, introduced in 1865 to control the Colorado potato beetle (Metcalf, 1971; Aldrich and Gooding, 1976). Metal salts, including thallium, zinc, copper, arsenic, lead, and mercury came into use at the beginning of the twentieth century (Aldrich and Gooding, 1976; Higgins and Burns, 1975). The "organic" era of pesticides began in 1939 with the discovery of the insecticidal properties of DDT and the later discovery of the organic herbicides such as 2, 4- dichlorophenoxyacetic acid (2, 4-D) (Higgins and Burns, 1975).

Pesticide use in the developing countries is widespread, for both the control of such diseases as malaria, and for protection of food crops from agricultural pests (Aldrich and Gooding, 1976; Vandekar, 1973). A major problem in this field is pesticide poisoning of humans. This has been reported (Vandekar, 1973) in a number of developing countries where agricultural workers have not been properly trained, nor have they been able to read the labels on pesticide containers. Another incident of major import occurred in Iraq (Bakir, et al, 1973) where grain treated with a methylmercury fungicide was ingested, resulting in 6,530 cases of poisoning and 459 deaths. Bakir, et al (1973) suggest that ignorance and a shortage of food were the primary causes for this outbreak.

Pesticides have been classified extensively in many sources (Hayes, 1975; Aldrich and Gooding, 1976; Chanlett, 1973; Salvato, 1972; White-Stevens, 1971; American Chemical Society, 1969; Higgins and Burns, 1975). The classifications provided by Hayes (1975) are presented in Table 4 with a few examples in each category.

TABLE 4

PESTICIDE CLASSIFICATIONS

1. Inorganic and organometallic pesticides (compounds of arsenic, lead, mercury, chlorine, fluorine, and others)
2. Pesticides derived from plants and other organisms (pyrethrum, nicotine, rotenone, sabadilla, strychnine)
3. Solvents, propellants, and oil insecticides (kerosene, xylene)
4. Fumigants and nematocides (chloroform, cyanides, phosphides)
5. Chlorinated hydrocarbon insecticides (DDT and related compounds, aldrin, chlordane, dieldrin, toxaphene)
6. Organic phosphorus insecticides (bromophos, malathion, dichlorvos)
7. Carbonates and related pesticides (zectran, carbaryl)
8. Phenolic and nitrophenolic pesticides (dinobuton, dinocap)
9. Miscellaneous pesticides (sulphenone)
10. Synthetic organic rodenticides (warfarin, sodium fluoroacetate)
11. Molluscicides (metaldehyde)
12. Herbicides and related compounds (2, 4-D, chlorbromuron)
13. Fungicides and related compounds (capton, chloranil)
14. Chemosterilants (aphalate, tepa)
15. Repellants and attractants (choralose, deet)

The general properties of pesticides specified as important by the American Chemical Society (1969) in their toxicology include: a tendency to vaporize, a tendency to dissolve in water or other solvents, a degree of resistance to degradation in the environment. The degree of resistance to degradation varies greatly between different compounds; half-lives ranging from two weeks to two years for the chlorinated hydrocarbons. This resistance is often increased in water (WHO, 1972). The organochlorines (e.g., DDT) are highly lipid soluble and therefore tend to be stored in fatty tissue (Moriarty, 1975). Their hydrophobic nature also facilitates adsorption to suspended particles in water, on bottom sediments, and on organic matter in soil (Moriarty, 1975). Adsorption of particulates often prevents detection of their presence (Holden, 1975).

Pesticide residues persisting in the environment have been extensively evaluated to determine if existent levels are hazardous in the soil, water, and, to a lesser degree, in the air. (American Chemical Society, 1969; Moriarty, 1975; Holden, 1975, Metcalf, 1971). The most common soil residues are the chlorinated hydrocarbon insecticides, including DDT (American Chemical Society, 1969; Chanlett, 1973; Salvato, 1972; Higgins and Burns, 1975). Agricultural problems associated with soil residues have been elaborated (Holden, 1975; Metcalf, 1971; American Chemical Society, 1969). Examples of these are: injury to crops, absorption by food crops, and harm to soil organisms. Holden (1975) discusses the results of sampling soil for persistent organic residues; reporting that, of those compounds investigated, dieldrin was most frequently detected in cropland, followed by DDT, aldrin, and chlordane. He further specifies that in noncropland, DDT was the most frequently detected, followed by dieldrin. The range of organochlorine insecticides in soil is most typically on the order of 1-100 ppm (parts per million). Food may take up residues from the soil or may be sprayed directly and is considered the primary source of pesticide exposure for the general populations of the world (WHO, 1972).

Typical concentrations of pesticides in water are usually measured in ppt (parts per trillion) (Holden, 1975; American Chemical Society, 1969). Water exposures are considered insignificant to health relative to levels obtained from food (WHO, 1972). Studies in the U.S. (American Chemical Society, 1969), have indicated that dieldrin is the most dominant pesticide in River basins, although endrin and DDT are also quite commonly discovered. A significant concern related to levels of pesticides in water is the tendency of pesticides to bioaccumulate up the food chain in aquatic systems, with harmful effects on fish and birds (WHO, 1972; American Chemical Society, 1969; Higgins and Burns, 1975).

Residues in air have not been well documented (Holden, 1975; American Chemical Society, 1969). The degree of exposure from air, however, with the exception of agricultural exposure during spraying, is considered negligible relative to food exposure (WHO, 1972).

The effects of pesticides on animal populations have been discussed by Dempster (1974). In summary, he first indicates that toxic substances such as pesticides have frequently been found to reduce or destroy populations of predatory species preferentially. Secondly he claims that this reduction most typically results in an increase in herbivore populations. The third issue he presents is that any form of pest control must affect populations of other species, due to interrelationships between populations in an ecosystem. Finally, he proposes that organochlorine pesticides pose special problems due to their persistance and resultant effects on fauna, and may cause secondary poisoning and sublethal effects.

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The effects of pesticides on animal systems have been extensively investigated (Colucci, 1974; Baker, 1973; Dempster, 1975; Vandekar, 1973; Moore, 1973; Kraybill, 1975; Klemmer, 1972; Hayes, 1975; Oser, 1972; and others). The primary focus of research in this area deals with effects of the persistent organochlorine pesticides, including DDT, heptachlor, dieldrin, chlordane, and aldrin (Moriarty, 1975). Pesticides and their toxicity in humans have been investigated extensively by Hayes (1969, 1975); Davies, et al (1974). Primary effects of pesticides have been categorized as storage, morbidity, and mortality (Moriarty, 1975).

Storage. Storage, or body burden, of pesticides has been widely studied (Durham, 1969; Walker, 1975), particularly with respect to the chlorinated hydrocarbons. Factors claimed to influence storage of a compound include intensity and duration of dosage, efficiency of absorption, age, sex, species, nutritional status, integrity of certain organs, particularly the liver and kidneys, and intake of certain drugs (Durham, 1969). Studies of the degree of storage of DDT in humans have been reviewed by Durham (1969). He summarizes the research performed in the U.S., Canada, India, Israel, and a number of European countries. Durham (1969) discusses a direct relationship between dosage and degree of storage of DDT; dosage derived primarily from food. A steady state phenomenon has been reported with respect to storage of certain chlorinated hydrocarbons affecting the above described dose-response relationship (Durham, 1969; Hayes, 1975).

The significance of storage of pesticides is being widely investigated. Durham (1969) reviewes a number of studies on storage in persons with various diseases. He relates no correlation between DDT levels stored and cause of death due to neoplasm, cardiovascular disease, infection, or accident. However, he states that direct correlations have been found between clinical signs of poisoning in rats and levels of DDT in the nervous system.

Morbidity and Mortality. A review of morbidity and mortality relationships to pesticide exposure has been provided by Hayes (1969; 1975). Acute exposures to pesticides have been widely reported, primarily in agricultural and disease control workers mishandling pesticides (Aldrich and Gooding, 1976; Vandekar, 1973; Hayes, 1975; Moore, 1973; Davis, 1969); by ingestion of foods containing highly toxic pesticides (Bakir et al, 1973), or in workers involved in the manufacture of pesticides (Aldrich and Gooding, 1976). Aldrich and Gooding (1976) review the literature on the physiological effects of pesticide exposures. Areas of investigation include central nervous system effects in mammals resulting in convulsions, tremor, fever and death, and hepatotoxicity in rodents. Abnormalities in human hepatic function were not reported (Aldrich and Gooding, 1976). Studies are also described (Aldrich and Good, 1976) relating similarities between DDT derivatives and steroid intermediates and their possible modification of steroid metabolism. The above review also discusses studies of the physiological effects of aldrin, dieldrin, endrin, chlordane, and heptachlor as well as brief discussions of effects under investigation related to the other major pesticide groups.

Extensive research is currently being performed on the carcinogenicities of many pesticides (Kraybill, 1975; Hayes, 1975). Problems involved in the study of potential carcinogenicity are well known and are discussed with respect to pesticides by Hayes (1975). A primary factor is translation of animal data to human data. With this in mind, it may be stated that many investigators report tumorogenic properties in laboratory animals of certain pesticides, including DDT, aldrin, and dieldrin (Hayes, 1975). This review reports other effects induced in animals including hypersensitivity to cold, fibrosis of the lung, central and peripheral nervous system effects, and necrosis of the liver and kidneys (Hayes, 1975).

The critical issues in the determination of health hazards from pesticide exposure are: the difficulty in determining level of exposure, confounded by many internal and external effects (Ahyes, 1975; Aldrich and Gooding, 1976); the relationship (or lack of it) between animal toxicity data and human toxicity (Moore, 1973); the possibility of long-term effects (Hayes, 1975).

Pests and Pest Control

Pests of primary concern are the disease carriers (e.g., mosquitos, flies, fleas, lice, roaches, rats, mice, and snails) and the agricultural pests (primarily insects and rodents). Diseases associated with insect vectors include plague, filariasis, onchocerciasis, malaria, dengue, trypanosomiasis, sand fly fever, and chagas disease (Chanlett, 1973). Rodents are known to carry many disease organisms on their bodies as do roaches, and flies. The literature on vector-borne and pest-related diseases is voluminous. It will not be examined in this review. The literature review on communicable diseases should be consulted for that information.

According to the World Health Organization (1972), one estimate indicates that 33 million tons of bread grains and rice are destroyed or rendered inedible by rodents annually, and the degree of damage by insects is at least as great, if not greater. Another estimate in 1966 indicates that damage by rats in the U.S. alone cost $10 per rat, with a rat population of 10 million (Chanlett, 1973).

Programs for pest control have been classified as either mechanical, cultural, biological, or chemical (Chanlett, 1973; Salvato, 1972; American Chemical Society, 1969). A great deal of experimentation has occurred within each of these areas. A brief summary of the advantages and disadvantages of each of these areas will be provided.

Physical or mechanical control may involve the use of barriers or some means of temperature adjustment (Chanlett, 1973; Purdom, 1971). These methods are often expensive and temporary, however, immediate results may be observed.

Cultural control, primarily useful in agriculture, involves such practices as crop rotation, mixed planting, adjusting planting around pest life cycle, or the use of resistant plant varieties. Biological control may involve the introduction of predators, parasites, or diseases into a pest population or the use of radiation or chemosterilants. Extensive research in the area of biological control exists in the literature (Loomis and Broadman, 1977; Tschirley, 1974; Darsie, et al). The primary advantage of biological control is that no toxic substances are involved, however, the disadvantages include: time expended for development and to gain results, the level of control may be unacceptable and some pests may have no natural enemies.

Chemical control has been discussed extensively in the section on pesticides. Its advantages include relative inexpense, fast results are obtained, and the achievement of a high level of control (a critical consideration in the control of disease vectors). The disadvantages of chemical controls include: persistence in the environment, harm to organisms, possible chemical interactions producing unknown effects, and pest resistance. Many insects have been found to develop resistance to pesticides (Brown, 1969; Brown, 1971).

The current trend in pest control is toward an integrated pest management (Barnes, 1975; Darsie et al; Brown, 1969; Tschirley, 1974; Bang et al, 1975; Loomis and Boardman, 1977). This is especially true in the case of the control of agricultural pests.

In terms of disease control, controversy still exists with respect to the advantages and disadvantages of pesticide use. Moore (1973) discusses this controversy and suggests that an ecological approach be applied to the use of pesticides. Aldrich and Gooding (1976) stress the inevitability of pesticide use and propose caution and further research into harmful effects. They emphasize the importance of understanding the synergistic effects often exhibited by pesticides. Victor and Mansell (1975) point out the need for the application of cost-benefit analysis to pesticide investigations and describe social, political, legal, and economic factors to be considered in the establishment of a program for pesticide use. Shimkin (1969) in summation of a conference on "Biological Effects of Pesticides in Mammalian Systems," discusses the pesticide controversy and proposes certain alternatives. He suggests the following principles: that absolute safety is unattainable; that studying the consequences of all factors of the total environment is not possible; and that answers must reflect the nature of the questions posed. His final proposal supports the necessity for an informed and involved citizenry, that stringent national policies with respect to pesticide use should be developed and enforced, and that technological personnel and resources to carry out policies must be available at regional and national levels.

RADIATION

Radiation is the emission of energy from a point of origin. The first demonstration of X-rays, a form of radiation, took place in 1895 by Wilhelm Roentgen. Henri Becquerel discovered, in 1896, that pitchblende ore could darken photographic film. He also showed that the ore contained small amounts of uranium and thorium salts which emitted energy in the form of penetrating radiations similar to X-rays. Pierre and Marie Curie continued this work by demonstrating that smaller quantities of a third radioactive element, radium, were also present in the ore. Additionally, they discovered that radium evolved a gas, known as radon, which is itself radioactive. Since pitchblende ore is relatively widely distributed throughout the earth's crust, it became apparent that the environment contained a hitherto unrecognized factor that subsequently became known as radioactivity. (Rumsey, 1973).

An account of Becquerel recalls that he carried a tube of radium around with him in his pocket for demonstration purposes. The radium did not harm the fabric of his waistcoat, but it produced a burn on his body (Rumsey, 1973). This initial demonstration that radiation was capable of harming living tissue, in this case causing skin erythema, also suggested that this property of radium might be adapted and controlled for the treatment of malignant tumors. As radiologists and chemists began working with uranium, thorium, and radium, they began to contract diseases of the blood and certain types of cancer. It became clear that radioactivity produced a generalized deleterious effect on the human body. The detonations of atomic bombs and testing of more powerful devices have resulted in radioactive contamination of the global environment and illness. Much research on the varied effects of radioactivity has been carried out in the last two decades, but the state of knowledge remains unsatisfactory (Howe and Loraine, 1973; WHO, 1972).

Types of Radiation

Radioactivity is energy liberated by the fragmentation of large atoms into smaller ones. This may occur naturally as with atoms such as uranium, thorium, or radium, or it may be produced synthetically, a process known as nuclear fission, resulting in the release of vast amounts of energy in the form of heat, light, noise, and radiation (Rumsey, 1973).

A brief elementary review of the characteristics of the atom is useful for understanding the types and effects of radiation. All atoms are composed of protons, electrons, and neutrons, except the hydrogen atom, which contains a proton and an electron. When atoms combine to form compounds, the resulting molecule usually has the same number of electrons as it does protons and, thus, it is electrically neutral. The electron is the lightest part of the atom, and the electrons are not as tightly bound to the nucleus as are the neutrons and protons bound together in the nucleus. The electron is more mobile and can be removed from an atom or molecule with little expended energy. When an electron is removed the resulting component is electrically charged and is by definition an ion. Ions may be charged positively or negatively and may exist in crystals, liquids, and gases. Any process by which a neutral atom or molecule loses or gains electrons, resulting in a charge, is known as ionization (Salvato, 1972).

The ionization resulting from radiation absorption has significant health effects. The production of ions within tissues can injure plants and animals as well as cause somatic and genetic damage in human beings. The types of damage caused, methods of detection and the means of controlling exposure to ionizing radiation will be discussed in later sections.

The common types of radiation are X-rays, gamma rays, neutrons, alpha particles, and beta particles. X-rays and gamma rays are similar. A brief description of these types and their characteristics as presented by Salvato (1972) appears below:

"Alpha particles have large specific ionization values. Since they create many ions per unit of path length, they dissipate their energy rapidly and penetrate only 3 to 5 cm of air. A thin sheet of paper will stop the particle. Alpha particles have a positive electric charge, exactly twice that of an electron, and a mass of four, the same as a helium atom. The particles are normally a hazard to health only in the form of internal radiation.

"Beta particles are light in weight and carry single charges. They are high-speed electrons that originate in the nucleus. Their specific ionization values are intermediate between those of alpha particles and gamma and X-rays. They ionize slightly, dissipate their energies rather quickly, and are moderately penetrative but are stopped by a few millimeters of aluminum. Beta particles can be a health hazard either as internal or external radiation due to the ionization in the tissues.

"X-rays and gamma rays move with the speed of light. The only difference in this respect between gamma rays, X-rays, and visible light is their frequency. X-rays and gamma rays ionize slightly in travel and are very penetrating compared to alpha and beta particles. They constitute the chief health hazard of external radiation, although gamma rays can be a hazard also as internal radiation. Whereas gamma rays come from the nucleus of an atom, X-rays come from the electrons around the nucleus and are produced by electron bombardment. As is commonly known, when X-rays pass through an object, they give a shadow picture of the denser portions on film or a special screen.

"Neutrons are uncharged high-energy particles that may be given off under certain conditions and can have both physiological effects and the ability to make other substances radioactive. Neutrons present major problems in areas around nuclear reactors and particle accelerators.

" Radionuclide is a radioactive isotope of an element. A radionuclide can be produced by placing material in a nuclear reactor or particle accelerator (cyclotron, betatron, Van de Graff generator) and bombarding it with neutrons. Radionuclides have particular application as tracers in many areas of medicine, industry, and research. Mixing a radionuclide with a stable substance makes possible study of the path it follows and the physical and chemical changes the substance goes through."

Radiobiology -- Biological Effects of Radiation

Radiation which is capable of producing ionization and which is absorbed can cause damage and injury. It is thought that the harmful effects of ionizing radiations come from their contact with atoms and molecules in the living protoplasm. It has been suggested that the ionizing radiation influences the normal chemical processes within the cell with the formation of other molecules and/or substances. These may in turn cause other effects (Rumsey, 1973; Salvato, 1972; WHO, 1972; Upton, 1969).

Measurement

In considering radiation units, it is necessary to distinguish between the following four quantities: exposure, absorbed dose, dose equivalent and rate of disintegration.

Exposure is the sum of electrical charges of the ions of one charge present in a unit mass of air under certain conditions. The unit of measurement is the roentgen (R). It is applicable only to X-rays and gamma rays.

The absorbed dose is the radiation energy imparted to unit mass of a specified medium. The unit of absorbed dose is one rad which represents the absorption of 100 ergs. per gram of medium.

The rem, short for roetgen equivalent man, is a measurement unit designed to take into account the biological effectivenss of a given absorbed dose or dose equivalent. A quality or damage factor is used to convert rads to rems for radiation protection considerations.

The rate at which atoms of radioactive sources disintegrate is measured in curies. The radioactivity of one gram of radium is approximately one curie.

Different organisms as well as different cell types within the same organism possess varying degrees of radiosensitivity. For instance, dosages of some thousands of rems are required to impair the reproductive capacity of certain bacteria, whereas the growth of certain human cells is inhibited by as little as 100 rems (Rumsey, 1973). In humans, the lethal dose of radiation to the whole body varies from 100 to 1,000 rems. In the human body the most sensitive tissues include the gonads, the lymphatic glands, the haemoietic cells of the bone marrow, and the small intestinal mucosa (Forester, 1973; Rumsey, 1973). Young cells and children's tissues are more radiosensitive than are those of adults. Absorbed dosages of radiation are frequently quoted in terms of a particular organ of high sensitivity, for example, the "gonad dose" or the "bone marrow dose." Measurement of low-energy radiation and its biological effects is discussed in detail by Gibson (1974).

The biological effects of radiation depend not only upon intensity of the radiation but also on the time of exposure. Natural radiation exposes the human body at a constant rate of approximately 0.1 rems annually. A radiological examination may produce a similar annual exposure but at a far higher dose rate, the actual exposure lasting only fractions of a second (ICRP, 1970).

Sources of Environmental Radiation

The sources of radiation are categorized as internal or external depending on whether the source is inside or outside the body. Internal radiation occurs following the ingestion or inhalation of radioactive substances. If such substances are not excreted but instead are incorporated into the tissues of the body, then the source rests permanently in contact with living cells causing the maximum potential damage (Howe and Loraine, 1973).

Natural radiation has four components: terrestrial radiation, cosmic radiation, atmospheric radiation, and internal radiation (WHO, 1972; Rumsey, 1973; Miller, 1974).

Terrestrial radiation emanates from natural radioactive elements such as thorium, uranium, and radium that occur in the earth's crust and soil. These elements are still present and exist because of the long half-lives they possess. The absorbed dosage of gamma rays from this source varies because of the varied soil and rock compositions that exist in different parts of the world.

Cosmic radiation originates in outer space and reaches the earth's surface after reacting with, and being partially absorbed by, the earth's atmosphere. The dosage from this source varies by approximately 14 percent with latitude, but to a far greater degree with altitude above sea level (Rumsey, 1973).

Atmospheric radiation comes from the radioactive gases radon and thoron present in minute amounts.

Internal radiation constitutes approximately one-fifth of all natural radiation dosage. The most important radioisotope is potassium 40 with carbon 14 contributing to a lesser degree. Recently, it has been discovered that the human diet furnishes the body with varied amounts of radiation mainly in the form of alpha emitters such as radium and thorium (Miller, 1974).

Sources of man-made radiation can affect the total population of the planet or a significant portion of the population in a particular country, and individuals who come in contact with radiation typically because of their occupation. The wide variety of hazards generated by man-made radioactive agents are reviewed by Brodine (1976). He discusses the means of assessing and evaluating these dangers as well as alternative technologies. The literature reflects five sources of radiation that will be briefly described here: fallout from nuclear explosions, nuclear power plants, medical radiology, occupational exposure, and consumer goods.

The detonation of nuclear devices in the atmosphere produce radiation pollution that affects the entire planet. The radioactive substances injected into the stratosphere are deposited on the earth through rainfall (Rasmussen, 1974). Those substances that decay rapidly (i.e., those that have short half-lives) have largely vanished, but radioisotopes with a long half-life, such as strontium 90, caseium 137 and carbon 14 still affect humankind (Vaughn, 1976). (Strontium 90 has a half-life of 28 years; caesium 137, 30 years; and for carbon 14, 5,640 years.)

Radioactive fallout affects humans in two ways: (1) by radiation from fallout deposited on the ground; and (2) radioactive materials assimilated into plants that pass into the human body directly or indirectly (as in milk and its products). Once ingested, caesium 137 and carbon 14 are distributed evenly throughout the body. Caesium 137 is excreted from the body within a few months. However, the effects of strontium 90 are much more hazardous. Rumsey (1973) explains, "The body is unable to distinguish between the elements strontium and calcium, so that both are incorporated almost permanently into bone. As a result, radioisotopes of strontium irradiate the blood-producing cells of the bone marrow as well as the entire human skeleton."

The United States Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) estimates the dose commitments from fallout. See Miller (1974), Forester (1973) and Gray (1976) for additional current information on exposure and health effects from this source.

The increased use of and interest in nuclear industry has been accompanied by a vast literature on the human and ecologic effects of these plants. Sagan (1974) discusses these effects emphasizing the sources and quantities of radioactive materials that enter the environment. The International Atomic Energy Agency (1973) recently published a series of papers on topics surrounding the production, behavior, and effects of radionuclides released by nuclear industry. Eichholz (1976) presents design and technical features of these power plants that affect the environment and discussions of the treatment of radioactive effluents. The American Nuclear Society (1976) has published a very valuable series of papers in Controlling Airborne Effluents from Fuel Cycle Plants. These papers discuss methods of measuring the transport and dispersion of these effluents (Hanna, 1976), plant retention of the effluents (Vaughan, 1976), dose consequences (Kahn, 1976), government control (Richardson, 1976), and many other important aspects of nuclear power usage. Efficient and economical use of radioactive wastes is discussed in Davis (1974).

One of the most common types of ionizing radiation in developed nations is the X-ray. It is produced by fluoroscopic equipment, radiographic equipment, X-ray therapy equipment, dental X-ray machines, X-ray diffraction apparatus, industrial X-ray machines, the shoe-fitting fluoroscope, etc. (Salvato, 1973). Individuals undergoing routine X-ray procedures with this equipment are not considered at risk (Rumsey, 1973). A genetic dose to the whole population is estimated by integrating the doses absorbed from each radiological procedure for total number of persons irradiated.

The increasing use of radioactivity in industry and medicine and the proliferation of nuclear power plants has increased the number of people exposed to radiation (Salvato, 1973; Forester, 1973; Landau, 1974). The dose of radiation received by workers in these industries is monitored by means of radiation-sensitive film badges designed to conform to international standards of radiation safety (Biology and Health Physics Division Report, 1974).

Standards of radiation safety are expressed as maximum permissible doses which are agreed upon by the International Commission on Radiological Protection (ICRP). These ICRP recommendations are universally accepted (Rumsey, 1973). Since it is not possible to state with certainty that any dose of radiation is harmless (Landau, 1974), ICRP recommendations are based on practical considerations which attempt to balance the advantages and hazards of using radioactivity. Thus, maximum permissible doses for occupational exposure are higher than those for the general public. Landau (1974) reports on the problems associated with assessing low dosages and the difficulties in carrying out monitoring schemes for the public.

The radioisotopes present in the luminous dials of watches and clocks, and in television receivers, create absorbed dosages of radiation that are negligible. This has resulted from the introduction of isotopes with emissions of low penetrative power (Rumsey, 1973; WHO, 1972; Brodine, 1976).

The Effects of Radiation on Health

The effects of ionizing radiations on health are generally classified under two headings: somatic disease and genetic damage. Both somatic disease and genetic effects from radiation exposure may not be evident for months, years, or a lifetime. A dose of 500 to 2,000 rad of total body irradiation, delivered over a short period of time, results in death within about a week (WHO, 1972).

Cancer is the most predominant somatic disease or condition caused by low dosage levels of radiation. The appearance of the first symptoms can vary from two years to thirty years after original exposure (Rumsey, 1973). There is evidence of other late effects following high doses: cataract formation, possibly neurological damage, general shortening of the life span, impaired fertility, bone marrow atrophy, a reduction in the cellular defense mechanism against infection, and impedence of growth and development following previous irradiation in utero (Rumsey, 1973; WHO, 1972).

The frequency of different types of tumors has been found to be higher in irradiated populations. This is true of thyroid carcinomas in patients given X-ray therapy to the neck in childhood, carcinomas of the lung in workers engaged in mining uranium ores, haematite and fluorspar, haemangioendotheliomas of the liver in patients injected with drugs containing thorium, and miscellaneous types of neoplasms in atomic bomb survivors and in patients subjected to radiotherapy (United Nations Scientific Committee on the Effects of Atomic Radiation, 1969, cited in WHO, 1972). The occurrence of these diverse growths indicates that the neoplasms caused by irradiation may result from irradiation in widely differing conditions of exposure.

Knowledge of the long-term effects of acute and chronic doses of radiation is far from complete. Brodine (1976), the ICRP publications, Miller (1974), Sagan (1974), Forester, (1973), Cohen (1976), should be consulted for current and more detailed descriptions of this research on tissue sensitivity, disease effects, and dose estimations.

The mechanism through which radiation induces genetic damage is unknown but the effect on the cell nucleus is known to be two-fold (Rumsey, 1973). First, radiation may directly damage and thus modify chromosomal structure, and secondly, radiation may increase the gene mutation rate. In successive generations, both these genetic changes can be manifest in general reduction in intelligence, emotional stability, physique, viability, and other attributes and in specific visible detriments resulting in disease states (Miller, 1974).

The relationship between biological effects, health effects, and doses of radiation is currently being identified (Landau, 1974). The importance of this research and the problems associated with hazard assessment are summarized by Rumsey (1973): "The need for safe maximum permissible dose levels is of paramount importance if the predictions for the future use of nuclear energy and all other forms of radioactivity are to be fulfilled. Safe dose levels are estimated, however, by extrapolation from observations on the effects on humans of much higher doses of radiation. Moreover, these higher doses are never continuous, varying from a single dose resulting from a nuclear bomb detonation to a small series of exposures arising from radiotherapy courses for ankylosing spondylitis. Experiments on various laboratory species provide valuable information on the relationships between radiation dose and cellular damage at lower dose rates. Nevertheless, the science of hazard evaluation in radiobiology is still imprecise mainly because the dose-response relationships at low levels of radiation exposure in the human remain unclear."

OCCUPATIONAL HEALTH

The hazards encountered in the occupational environment are numerous, resulting from a multitude of physical, chemical, biological, and psychosocial influences. A complete analysis of hazards encountered in the work environment has been provided by Mayers (1969). Research in this field abounds and is growing; occupational health being a critical concern in the developed countries particularly (CIBA Foundation, 1975).

Chemical Health Hazards

Toxic or harmful chemicals may be classed as dusts, fumes, mists, vapors, gases, or solvents (American Chemical Society, 1969). The degree of damage incurred by the human body, as is well-known, depends on the extent and duration of exposure.

Dusts may be of organic or inorganic origin; resulting from fragmentation of rock, metal, coal, wood, and grain. Following inhalation, certain inert dusts will be easily eliminated from the respiratory tract while others, such as silica, will be retained reulting in pulmonary fibrosis (Waldbott, 1973; Paretto, 1971; WHO, 1972). Other pulmonary fibrotics include barium, carbon, cobalt, and iron oxide (Waldbott, 1973).

Coal, although typically expelled from the respiratory tract, is known to be involved in the causation of "black lung," a fibrotic disease typical in coal miners after many years of constant exposure (Waldbott, 1973; Naeye and Dellinger, 1970; Lanehart, et al., 1968).

Asbestos, a fibrous silicate, presents a hazard to health as both a fibrosis-producer and in the causation of mesothelioma and lung cancer (Waldbott, 1973). Exposures are common in the construction industry, asbestos mines, textile industry, and in manufacture of fire-proof equipment.

Lead may occur in the air as a dust or a fume; emitted most typically from mines, smelters, paint manufacture, welding, gasoline, and battery manufacture. Human contact with this element occurs from air, water, and food by inhalation, ingestion, or dermal contact. The health effects of lead exposure are of current concern internationally and extensive recent literature exists on the subject (Smith, 1976). Chronic lead poisoning in children between the ages of 1 and 3, associated with "pica," and often leading to permanent neurological damage, mental retardation, and epileptic seizures, is of critical concern (Waldbott, 1973; WHO, 1972). Other associations with lead poisoning include sterility in women, abortions, stillbirths, and premature births (Waldbott, 1973).

Solvent vapors of toxic hydrocarbons are commonly contacted in a variety of industries too numerous to elaborate. General effects associated with many of these include anesthesia of the central nervous system (WHO, 1972). Literature related to other, more specific effects, is extensive.

The most significant gases encountered in the work environment, especially from a consideration of ubiquity, are carbon monoxide and sulfur dioxide. The health associations of these substances have been addressed in the discussion of air quality in this paper.

Physical Health Hazards

Physical agents, primarily vibration, lighting, ultraviolet radiation, heat, and cold, are frequent causes of illness and injury (Phoon, 1975). Exposure to vibration over an extended period of time has been found to cause injury to joints (WHO, 1972). Levels of illumination for the performance of certain tasks have been established (Jones, 1959). Long term exposure to insufficient lighting may lead to acute and chronic effects exemplified in miners' nystagmus (WHO, 1972). Ultraviolet radiation exposure associated with acute conjunctivities and keratitis has been reported although disability does not appear to be permanent (Olishifski and McElroy, 1971). Work in an extreme cold environment has been associated with erythrocyanosis, immersion foot, chilblains, and frostbite (WHO, 1972). Heat stress has been found to lessen alertness and has been correlated with increased accident rates (Metz, 1967).

Biological Health Hazards

Those occupational diseases of biological origin are often common in the developing nations, especially where proper sanitation is not practiced. Some of the more common examples are listed here: anthrax from wool-sorting of infected hides; bagassosis from fungi in cotton; tetanus from wounds; brucellosis from contacting infected animals in the slaughterhouse; ancylostomiasis and schistosomiasis in plantation workers (WHO, 1972). Czapski and Kloetzel (1971) report that 59 percent of those Brazilian plantation workers regularly contacting water in the course of their duties contracted schistosomiasis as opposed to only 10 percent of the unexposed workers.

Control Techniques

An important aspect of industrialization on the increase in occupational environments in developing countries is the potential increase in health hazards. Industrialization increases the variety of pollutants, degree of pollutants, and health hazards in the environment. Although industrialization often upgrades the economic and social status of some people, the long range and latent health effects of such changes must be considered.

Two effective strategies for controlling health hazards encountered in the occupational environment are monitoring (of sources and individuals) and incorporating safety measures in the expanding technology (CIBA Foundation, 1975).

AIR QUALITY

An historical perspective of air pollution from primitive times to the present has been provided by Stern (1968), detailing pollution problems associated with the least developed societies to the most developed. In industrial societies, air pollution hazards associated with smoke from domestic heating and cooking or airborne naturally occurring substances such as allergens existed. The advent of coal burning for energy initiated the generally recognized beginnings of air pollution. Smoke and sulfur dioxide are the primary pollutants produced, causing significant reduction of visibility and increased discomfort. The substitution of petroleum products for coal produced further air pollutants: nitrous oxides, carbon monoxide, hydrocarbons, and lead, and under special conditions, the most toxic photochemical oxidants, ozone and peroxyacylnitrates.

The relative importance of air quality to the developing countries has been questioned by many experts in the field Governments often choose to trade air pollution for increased affluence (Kirov, 1975; Hanlon, 1977). It has been documented, for example, in India, that people are aware of the existence of air pollution but do not believe that it constitutes a problem in the context of other more serious health hazards (Bladen and Karan, 1976). Another consequence of this deliberate ignorance of air pollutants is the lack of attention to air quality. Some researchers (Mustafa, 1977) purport that not until air pollution is recognized as significant in a society will adequate data be collected to determine its extent and impact on health.

Pollutants

Natural sources of air pollution are numerous including fog, windblown dusts, airborne allergens such as pollens, and natural radioactive particles. However, the most ubiquitous and harmful substances are by-products of human civilization from metallurgical plants, power plants, domestic heating, refuse burning, grinding, demolition, transportation, and industry (Stern, 1968; WHO, 1972; Mustafa, 1977).

The air pollutants generally considered significant to health are the oxides of sulfur, oxides of nitrogen, carbon monoxide, hydrocarbons, iron oxides, lead, beryllium, other dusts such as silica, and the photochemical oxidants: ozone, perosyacyl-nitrate, and nitrogen dioxide (Waldbott, 1973; American Chemical Society, 1969).

Health Effects

Data on the health effects of air pollutants are derived, primarily, from epidemiological and animal toxicity studies. Difficulties encountered in the establishment of cause and effect relationships between pollutants and health are compounded by the general long-term nature of health effects, the difficulties in measuring actual exposures of individuals, problems of translating animal to human data, inadequacy of human health data, and a paucity of environmental data on air pollutant levels (WHO, 1972; Stern, 1968; Mustafa, 1977).

Diseases most commonly associated with air pollution are: bronchitis, emphysema, asthma, lung cancer, chronic obstructive pulmonary disease, and pneumoconiosis or occupational lung disease (Goldsmith, 1968; Mustafa, 1977). Workers in the cotton and jute industries, common in the developing nations of Asia, have been found to contract byssinosis, a form of granulomatous lung disease (Goldsmith, 1968; El Batawi, 1974). Wood burning, a method still commonly used for cooking in many rural areas in developing countries, has been associated with a higher incidence of lung cancer (Cleary, et al., 1968; Smith, 1968; Steiner, 1964); and higher incidences of respiratory diseases in Children (Sofoluew, 1973). Other industries posing potential hazards to the respiratory system are the pottery industry, mining, and agriculture. These have all been associated with forms of fibrotic or granulomatous lung disease.

The effects of acute exposures to air pollutants are difficult to assess. Very few incidents of this type have been well documented either due to a lack of health data, a lack of environmental data, or both. Studies in the United States, Europe, and Japan have indicated a positive association between increased levels of sulfur dioxide and increased mortality, especially in the aged and those with chronic obstructive pulmonary disease complications (WHO, 1972).

Morbidity and mortality resulting from chronic exposures are also difficult to document. However, some studies indicate that mortality and morbidity due to respiratory causes increases in areas with high atmospheric pollution (WHO, 1972, Winkelstein, 1968, 1968; Morris and Shapiro, 1974; Beuchley, et al., 1973). Confounding variables such as cigarette smoking, occupational and previous exposures have led many researchers to perform studies with school children. These studies indicate an increase in respiratory illness with increased air pollution (Lunn, et al., 1967, 1970), and it has been postulated that these exposures may lead to chronic obstructive pulmonary disease later in life (Douglas and Waller, 1966; Paccagnella, et al., 1969; Symon, 1974; Kumpf, et al., 1974; Colley and Reid, 1970). The above studies primarily reflect the negative consequences of certain levels of smoke and sulfur dioxide.

The issue of the relationship of lung cancer to air pollution is controversial. A general review of this topic has been provided by the Royal College of Physicians of London (1970). Extensive literature exists supporting both a causal and a noncausal relationship.

Exposure to air pollution may also cause impairment of function and performance. Some researchers have found correlations between decreased respiratory function and increased air pollution in patients with chronic bronchitis and emphysema (WHO, 1972, Spicer, 1967; Lawther, et al., 1970; Remmers and Balchum, 1965). However, others have not observed this relationship under similar conditions (WHO, 1972, Rokaw and Massey, 1962; Schoetlin, 1962).

Intervention Techniques

Devices and methods for monitoring air pollutants are numerous and vary with the type of pollutant. Particulates are most commonly monitored by dust-fall determination, hi-volume sampler, centrifugal collector or impinger (American Chemical Society, 1969; Salvato, 1972). Smoke may be monitored by automatic smoke sampler or by use of the Ringleman Smoke Chart (Salvato, 1972; American Chemical Society, 1969). Gases are typically sampled using impregnated tape samplers or, for the most technically advanced, a continuously monitoring analyzer (Salvato, 1972; American Chemical Soceity, 1969).

Control Technologies

Approaches to pollution control include a substituion of the materials leading to air pollution, personal protection devices, dilution, isolation of the hazardous operations, and method and process changes. Most common is the use of emission control equipment.

Equipment for the control of air pollution emissions are designed to remove or reduce levels of particulates, aerosols, and gaseous by-products resulting from inefficient design and operation. Some common collectors, useful for dust control, are: settling chambers, cyclones, and sonic collectors (Salvato, 1972). Baghouse and cloth-screen filters are used to remove particles from gases, and electrical precipitators have application in power plants, cement plants, metallurgical refining, and chemical industries for the collection of fumes, dusts, and acid mists. Scrubbers are wet collectors generally used to remove particles that form as mists, and afterburners are used to complete combustion of unburned fuels and to burn odorous gases (Salvato, 1972).

The utility of the above equipment will, of course, depend on the extent of the air pollution problem, economic and manpower feasibilities, and other priorities established locally.

FOOD SANITATION

Food sanitation is considered to be a critical issue in the developing as well as the developed countries. As is well-known, food serves as a vehicle for a variety of disease organisms. Many surveys have been compiled of the types and sources of microbiological contaminants in food (WHO, Expert Committee on Microbiological Aspects of Food Hygiene, 1968; Frazier, 1970). Contamination of food may occur at any stage in its delivery to the table; initial contamination before processing, during food processing, during transport, handling in market or home, and from contact with water in the home.

Those types of foods typically presenting a hazard to health by microbial contamination are dairy products (Joint FAO/WHO Expert Committee on Milk Hygiene, 1970), fish and shellfish, meats (Joint FAO/WHO Expert Committee on Meat Hygiene, 1962), and eggs.

Contaminants

The biological contaminants are considered to be the most critical polluters of food in the developing countries (examples are found in Eason, Jr., et al., 1967; Worth and Shah, 1969; Buck, et al., 1970; Mata, 1976; Knight, 1973).

These may be classified as bacterial, viral and rickettsial, parasitic, and fungal. Characteristic bacterial diseases transmitted in food are: salmonelloses, botulism, staph infections, shigellosis, cholera, and diptheria (WHO, 1972; Chanlett, 1971). Viral and rickettsial diseases include infectious hepatitis, Bolivian hemorrhagic fever, and Q fever (WHO, 1972). Parasitic diseases such as trichinosis, tapeworm diseases, and protozoal diseases such as amoebic dysentery and toxoplasmosis are also common (Okpala, 1971; WHO, 1972; Chanlett, 1971).

Foods may also be contaminated with chemical substances usually contacted through the soil, water, or chemical sprays. These chemicals may be naturally occurring metals or nonmetals, or synthetics. The metals include lead, arsenic, mercury, cadmium, cobalt, tin, and manganese. The literature on these substances is extensive and will be considered in the discussion of water and water pollutants because they are usually found originally in that medium. Nonmetalic substances include the trace substance selenium and naturally occurring poisons such as mycotoxins (Aleksandrowica, et al., 1970) and ergot (WHO, 1972). Extensive research is being performed internationally on the mycotoxin aflatoxin (WHO, 1972) and a relationship between the incidence of human liver cancer in certain African countries and aflatoxin levels in foods has been suggested (International Agency for Research on Cancer, 1971). The incidence of liver cancer in the People's Republic of Mozambique, for example, was reported to be the highest in the world in 1972 (WHO, 1972).

Toxicants in foods from residues of chemicals used in growth and processing include pesticides, disinfectants, synthetic fertilizers, and growth regulators. The most ubiquitous and well studied of these are the pesticides. Pesticide contamination has been reviewed in an earlier section.

Food Sanitation Techniques

It has been reported that awareness and practice of food sanitation techniques in rural developing communities is inadequate (Eason, Jr. and Board, 1967; Worth and Shah, 1969; Buck, et al., 1970, 1972; Wolman, 1975; Knight, 1973; Sofoluwe, 1973; Wolman, 1974). Cultural and hygiene approaches to food protection goals within the traditions of most societies have been described as inversely related; where abundance and palatability (within the local frame of reference) are primary concerns and freedom from pathogens is least important culturally, these emphases are reversed from the hygienic perspective (Chanlett, 1971).

Intervention of sanitary techniques in the delivery of foods may be practiced at a number of stages: during growth and production, while handling foods, and during food processing. Principles of sanitary animal husbandry, inspection of animals before and after slaughter, inspection of crops, storage of foods at proper temperature and with protective covering, treatment of foods to kill pathogens, and home sanitation are basic measures recommended (Salvato, 1972; Chanlett, 1971; Purdom, 1971). Extensive literature exists on principles and practices of food sanitation (Shiffman, 1974).

Preservation of foods by some treatment procedure is typically recommended for disease prevention. Techniques include dehydration (e.g., freeze drying, sugaring, and salting), fermentation, curing, pickling, addition of preservatives, high temperature treatment (e.g., canning, pasteurization), and low temperature treatment (e.g., freezing). These methods will not be elaborated here. General reviews are available (Chanlett, 1971; Salvato, 1972; Purdom, 1971) and documentation of all techniques are abundant (WHO, 1968).

In the 1974 WHO "Guide to Simple Sanitary Measures for the Control of Enteric Diseases" the following recommendations are made regarding food sanitation: "Food sanitation programmes in the developing countries must take account of differences in the nature of the problem and in the possible solutions for rural and urban areas. The urban food sanitation in the developing situation countries (sic) varies throughout the world. However, there are a number of permanent food establishments, such as restaurants, food stores, and food processing plants, that are similar to those found in the more developed countries. Sanitation control for these establishments has been described in detail in many guides and legislative digests. However, most of these sources of information do not deal with the problems of the main purveyors of food in less developed countries, that is food vendors. The food vendor may be itinerant or he may sell food in the market or in some other place.

"The problem of sanitation for the vendors and in the food market is a major one in the developing countries, and the high ratio of food vendors to food control personnel accentuates it. One approach to solving the problem is to build new markets with water supply facilities to accommodate the food vendors; however, these efforts are not sufficient to deal with the continually expanding problem. The situation was assessed in a recent report on cholera (US Agency for International Development, 1971), which noted that it was not practicable to apply food controls to retail dood (sic) outlets; therefore, as much as possible should be done (sic) in the wholesale markets. For instance, the most fommon (sic) cause of food contamination is the practice of washing green vegetables with water that may be polluted. This is often done while the vegetables are in transit. Therefore, safe water should be supplied at supervised points along the route.

"The health problems of festivals and fairs are related to food vending sanitation. In India, for instance, religious festivals and pilgrimages are very important events in the lives of the people, and the role of such festivals in the epidemiology of cholera has already been mentioned. Indeed, vast numbers of people congregating in small areas create additional problems over and above those encountered in normal community sanitation. Refuse and excreta disposal and the supply of safe water are all connected with the food sanitation problem. Special measures that can be taken in regard to food sanitation include:

(1) prohibiting the sale of cut fruits and uncooked vegetables;
(2) covering food as a protection against flies;
(3) controlling the quality of water and ice used to prepare food and drinks;
(4) making provisions for the disinfection of utensils coming into contact with food, and promoting the use of single-service containers, including those made of leaves and burnt clay as well as the more modern varieties;
(5) organizing health education programmes, including the distribution of informative pamphlets."

NOISE

Noise has been defined as "a sound without agreeable musical quality, or as an unwanted or undesirable sound." WHO, 1972) The molecular movements of atmospheric gases create "sound pressure;" variations in atmospheric pressure. South pressure levels are expressed in microbars, decibels (dB), or dynes per square centimeter (Bell, 1966; Kryter, 1970).

The auditory system itself is complex and is further complicated by its associations with such systems as those of balance, vision, general activity level, and circulation. The sense of hearing, therefore, must be considered with respect to these related systems. For example, communication results from an interrelationship between hearing and phonation. Other variables interacting with hearing include age, sex, and sociocultural background.

Health Effects

The effects of noise are most easily measured with respect to impairment of hearing. However, these may include physiological, psychophysical, and psychosocial impacts on health and behavior.

The auditory field extends from 20 to 10,000 Hertz with the audibility threshold at its minimum at 4,000 Hz; the zone of impairment of the perception of high pitched tones occurring in the early stages of hearing loss (Cooper, 1975; Kryter, 1970).

The ear does possess a protective mechanism against noise, the acoustic reflex. This reflex is caused by simultaneous contraction of the stapedius and tensor tympani muscles, reducing the amount of energy transmitted to the sound receptors. This mechanism, however, is limited in its protective ability due to fatigue in the muscles involved and a 10 millisecond time delay.

Direct physiological effects of noise to humans include auditory fatigue, and the masking effect (Cooper, 1975). Auditory fatigue is manifested by a temporary threshold shift. This shift may increase with sound intensity, possibly leading to diplocousis and buzzing and whistling in the ears. Recovery may be slow with a threshold shift greater than 50 dB (Wisner, 1967). The most harmful sounds in this case have been found to be sudden, intermittent tones (Wisner, 1967; Mery, 1968).

The masking effect refers to a decrease in perceptibility of one sound in the presence of another, causing a shift in the audibility threshold of the masked sound. This effect is measured by SIL (Speech Interference Level). In everyday life, such noises as are caused by road and air traffic will typically produce the masking effect (Wisner, 1967; Mery, 1968; Kryter, 1970).

Presbycousis, or the impairment of hearing with age, is well-known and some have discussed the possibility of its relationship to noise exposure for extended periods of time (WHO, 1972; Mayer, 1976).

Nonspecific physiological effects of noise have been reported with regard to the cardiovascular system (Mery, 1968; Kryter, 1970), the respiratory system (Mery, 1968; Kryter, 1970), effects on the eye (Mery, 1968; Long and Jonsen, 1970), galvanic skin responses (Mery, 1968; Kryter, 1970), and changes in the blood and other body fluids (Kryter, 1970; Groguet, 1965).

Psychophysiological effects, mainly affecting sleep and work performance, have been reported (Kryter, 1970, Levere, 1975; Friedman, 1975). Psychosocial effects, primarily causing annoyance and irritation, have also been considered (Johsson and Sorenson, 1967).

In industry, a correlation has been found between high noise levels and high incidence of cardiovascular disease and stress related problems (Burns, 1977). Animal research supports the notion that noise produces stress reactions that are known to deteriorate the body and affect health (Goldstein, EPA, 1977). It appears that the negative effects of noise in industry are dependent upon two factors: the type of work involved, and specific characteristics of the noise (WHO, 1972).

Prolonged exposure to a sound leads to physical accommmodation and may be related to mental health. Thiessen (1977) exposed sleeping subjects repeatedly to low-level noises from trucks passing. Electroencephalograph recordings report that subjects shift into lighter stages of sleep out of REM. Long-term interruption of sleeping and dreaming is known to cause mental disturbances.

Pathological effects of noise are well-known regarding deafness induced by acoustic trauma following exposure to extremely high intensity noise (WHO, 1972; Cooper, 1975; Chanlett, 1973). Other pathological effects are not well-known (WHO, 1972).

Interventions

The measurement of sound levels is most easily accomplished with a sound-level meter or the more sophisticated sound analyzer (Kryter, 1970; Chanlett, 1973).

The World Health Organization (1972) has proposed control measures for noise protection. In the industrial environment these measures include: establishment of permissible sound levels; measurement of noise and its components, including noise from the background, from the general work environment, and from the source; reduction of noise at source; acoustic zoning; sound proofing; and provision of personal protective devices. In the home, measures of protection from outside noise include: control at the source; control of transmission through proper planning and engineering; and control at reception in the home through insulation. Baade (1971) suggests that the control of noise problems involves social and economic, as well as technical, control measures. Numerous studies recommend early preventive measures such as the use of sound insulated materials in the construction of buildings (Fasold, 1967) and the planning of communities such that homes are not adjacent to primary noise producers (Bragdon, 1973).

HOUSING

The WHO Expert Committee on the Public Health Aspects of Housing defined housing (residential environment) as "the physical structure that man uses for shelter and the environs of that structure including all necessary services, facilities, equipment, and devices needed or desired for the physical and mental health and social well-being of the family and individual." (WHO, 1961).

In most developing countries, the problems of housing call for urgent solutions. This is mainly the result of population increases and the growth crisis of people moving from rural to urban areas (WHO, 1972). In Africa, Latin American, and Asia, the urban population in many regions has doubled in the past ten years. This trend is expected to continue. At the time of the United Nations Conference on the Human Environment (1972), more than one thousand million people throughout the world lived in "substandard" housing conditions.

The two most prominent features of poor housing are overcrowding and a lack of basic sanitation. Poverty and filth are often closely associated with poor housing. A summary of the interaction of these factors is provided by the World Health Organization (1972) in Health Hazards of the Human Environment:

"Without a water supply, it is very difficult to maintain personal cleanliness, and wastes accumulate where there is no public service of refuse collection. Even when the occupants attempt, within the limits of their meagre resources, to improve the hygiene of their dwellings, the results are seldom lasting. This is mainly because the physical condition of the house, with leaking roof, cracked walls, and earth floors, facilitates the admission and accumulation of dirt, dust, and soot, and gives rise to dampness. Filth attracts lice, fleas, bugs, and mites that may transmit disease. Poor housing permits the harbouring of mice and rats, which can also be carriers and transmitters of disease, and the entrance of flies and mosquitos, with the resultant spread of such diseases as trachoma, malaria, yellow fever, filariasis, and dengue."

The growth of industry, proceeding in an unplanned fashion, heightens the environmental health hazards created by housing conditions. People from less developed areas move to urban centers seeking employment and better living conditions. If the facilities to house and maintain these people exist, they easily become overburdened, and over-crowded; poor sanitation, inadequate public health services, and adverse social conditions result. The U.N. Conference on the Human Environment (1972) made recommendations to minimize these adverse effects in developing countries. In development planning four elements should be included: national policies on population planning; careful siting of new industries to avoid overconcentrations of populations in a few centers; improvement of the facilities in rural areas surrounding an area in the process of industrialization (e.g., opportunities for education, training in integrated agricultural practices); efforts to preserve a sense of community among groups that have moved from rural to urban areas.

Health Effects

The history of studies on the influence of poor housing on health has been reviewed by Martin (1967). Martin, Kaloyanova and Maziarka (WHO, 1976) have developed an extensive annotated bibliography surveying research on the interrelationships of housing and health. In spite of advances in epidemiological techniques, there are difficulties in methodology with this research and the evidence produced is not conclusive (WHO, 1972). A few examples will illustrate the uncertainty that exists in this area of research.

Many studies have been made to assess the importance of housing conditions in relation to tuberculosis, but the results are conflicting: according to Stein (1950, 1954), Britten (1942), and Laidlaw (1946), higher mortality and incidence rates were associated with poor housing and overcrowding, but Benjamin (1953) could not distinguish the roles of income, housing, nutrition and/or occupation in relation to tuberculosis. McMillan (1957), Brett and Benjamin (1957) and others could find no relationship between overcrowding and tuberculosis. A number of researchers have pointed out the relationship between overcrowding and the incidence of rheumatic heart conditions, but it is doubtful how far those findings are still applicable (Martin, 1967). McLaren, et al. (1975) studied rheumatic heart disease in South Africa. In their discussion of preventive measures, the importance of socioeconomic factors, poverty, malnutrition, and bad housing, are stressed. A positive association between infant mortality and socioeconomic conditions was reported by Ellis (1956) but not confirmed by Willie (1959). Burt (1945) refers to a study in Melbourne which showed that infant mortality was twice as high and infectious disease rates three times as high in areas of poor housing.

The research on the relationship between housing conditions and mental health suffers from the same methodological problems. Too little is known about this relationship (WHO, 1974). It has been suggested that design and construction of a house may help to produce mental unrest and thus exacerbate mental disorders already afflicting the occupants; that sensory annoyance and dissatisfaction make an important contribution to mental unrest (Benichou and Schmitt, 1972; Chapin, 1951); and that gloomy, bleak surroundings may accentuate mental depression (Faris and Dunham, 1939). Lack of privacy and freedom of movement as well as isolation as a consequence of overcrowding are considered possible causes of mental unrest (Cappon, 1971; Chapin, 1951; Fanning, 1967; Grootenboer, 1962; Loring, 1964).

Recently the effects of rehousing on mental well-being and the effects of living in high-rises have been investigated (Hare, 1965, 1966; Kleevens, 1966 Lunn, 1961; Martin, 1957; Pozen, 1968; Robinson, 1955). Slum clearance has been clearly shown to result in improvement in health, in infant mortality and in the incidence of childhood diseases and tuberculosis. However, the importance of attending to psychosocial needs in these movements is equally clear. This facet of relocation has been dealt with most extensively in the case of the elderly. The stress related to relocation has been emphasized as a factor producing premature death (Wittels and Botwinik, 1974). The research demonstrates the need for planning in relocation and the realization that a full, rewarding life and environment must be provided for the aged and not merely shelter (Niebanck, 1965; Lawton and Yaffe, 1970; Brand and Smith, 1974; Kasl, 1972).

The relationship between quality of housing and physical or mental health is difficult to clearly demonstrate because of the many confounding variables related to housing. An increasing number of investigators (Loring, 1964; Tyroller and Cassel, 1964) are beginning to stress the need to examine the mechanisms through which housing quality may be linked to health. This approach suggests that the link may be quite indirect but that changes in physical structure alone may have no effect on health unless the intervening processes are understood and changed as well.

Control Techniques

Methods of controlling the effects of inadequate housing represent a major concern in this field. One approach is adequate planning. This is particularly important as an accompaniment to urbanization and industrialization in developing countries (WHO, 1974; Technical Report Series, No. 544; WHO, 1974, Report on a Seminar, Stuttgart; Tyroler and Cassel, 1964). Morris (1962) provides a strategy for urban planning that incorporates environmental health considerations (see also Molner and Hilbert, 1964). Several interesting community approaches to enforcement as a means to deal with inadequate housing have recently been reported (Richter, 1973; Society for General and Community Hygiene and the League of Architects, 1972).

Appraisal of the Quality of Living

The American Public Health Association's Committee on the Hygiene of Housing developed, from 1944 to 1950, an appraisal method for measuring the quality of housing. This method attempts to eliminate or minimize individual opinion so as to arrive at a reliable numerical value of the quality of housing that may be compared with results in other cities. It is also useful to measure the quality of housing in selected areas at regular intervals (e.g., 5 years) to evaluate the effects of an enforcement program or planning. The appraisal method measures quality of dwellings as well as the environment in which they are located. The items are grouped under "Facilities," "Maintenance," and "Occupancy." The rating of housing quality is based on a penalty scoring system. Salvato (1972) recommends that the application of the APHA appraisal method requires trained personnel and experienced supervision.

Other techniques for making rapid appraisals of the physical environment include aerial surveys, external ground level surveys, and Public Health Service Neighborhood Environmental Evaluation and Decision System (NEEDS) (1970). The APHA Committee on the Hygiene of Housing has listed the criteria to be met for promotion of physical, mental, and social health on the farm as well as in the city dwelling (Salvato, 1973). Basic Principles of Healthful Housing published by APHA in 1938 offers thirty basic principles with specific requirements and suggested methods of attainment for each.

The World Health Organization offers an "Appraisal of the hygenic quality of housing and its environment" (Report of a WHO Expert Committee, Technical Report Series, No. 353, 1967). This report is concerned mainly with methods for appraising housing quality. Included are: the fundamentals of surveys, appraisal methods, sampling techniques, the grouping of items for evaluation, and the application of various data processing methods.

CONCLUSION

This paper has presented an overview and description of the literature concerned with "those forms of life, substances, forces, and conditions" in the environment that may influence the health of human beings. Although this presentation has been limited to fundamental issues, the increasing range and complexity of health problems arising from the physical environment and man's manipulation of it is apparent in the discussions of each subsystem. The range, complexity and intensity of these consequences for health are particularly pronounced in the developing nations.

A critical feature of environmental health that underlies the material presented is the enormous web of interrelationships that exists between the ten subsystems considered here. The complexity of the total environment and the patterns of dependence between organisms and various components of that environment have only been alluded to. Yet, the successful solutions to health hazards are rarely unitary. For the purposes of the health of humankind and the preservation of the total environment an ecological perspective is also necessary.

In Health and the Developing World, John Bryant (1969) presents this overview of the state of health in the world: "The challenge is to provide effective health care for all the people of each nation. To do so involves a complex chain of concepts, techniques, people, decisions, and events that reach from the reservoir of biomedical knowledge to the people in need. If critical elements in that chain are missing the need will not be met."

This review provides an introduction to the portion of that chain which links the environment to human beings.

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HOUSING . . . . References 423 - 462

GENERAL ENVIRONMENTAL HEALTH

1.

Azurin, J.C. and Alvero, M., "Field evaluation of environmental sanitation measures against cholera," Bulletin of the World Health Organization, Vol. #51: pages 19-26 (1974).

Data obtained in a controlled field study over 5 years in 4 communities showed that the provision of sanitary facilities for human waste disposal can reduce the incidence of cholera by as much as 68%, while the provision of a safe water supply can decrease it by 73%. Where both toilets and water supplies are provided, the incidence can be reduced by as much as 76%. There was evidence that cholera infection gaining access to communities with these facilities tends to spread less and produce fewer secondary cases than in a community where such facilities are not provided.

2.

Bederka, John P. On the toxicity of our environment. Journal of the Medical Association of Thailand, vol. #54 (5): pages 335-348 (1971).

The author describes the paper: "I will consider briefly some aspects of our environment. These considerations are mostly of those that have been studied in greatest detail, or, in some cases, those that have been speculated about at greatest length. I will begin with the air that we breathe, then proceed in the direction of the air and the water relationships, and finally to the food sphere with a brief consideration of studies on birds and other vertebrates as they relate to ourselves. I will close with a consideration of some heavy metals in their capacities as pollutants."

3.

Bernstein, A.D. "Clinical investigation in Northwest Quebec, Canada of environmental organic mercury effects." In: Recent Advances in Assessment of the Health Effects of Environmental Pollution, International Symposium. Paris, France: World Health Organization, 1974.

In 1971, residents of three Cree Indian communities in Northwest Quebec, Canada, were investigated for possible clinical effects of organic mercury. This was done after finding that mercury levels of fish caught in the area ranged to greater than three parts per million. In the first phase of the investigation, over three-hundred persons had blood samples drawn for mercury determination. Many of these individuals had hair specimens for mercury determination collected as well. Approximately half this number had field clinical testing done. Clinical evaluation included full or screening types of history and physical examinations, electromyograms, and maze performance testing. Twenty-two individuals were found to have whole blood mercury levels greater than one-hundred parts per billion, the highest reading being three-hundred-and-six parts per billion. There was good correlation between hair and blood mercury levels. There appeared to be some relationship between the individual's fish consumption and his blood mercury level. No significant clinical findings suggestive of organic mercury excess were detected.

In the second phase of the investigation, five individuals from one of these communities, four of whom had previously shown blood mercury levels greater than one-hundred parts per billion, underwent extensive in-patient evaluations at the Montreal Neurological Hospital in Montreal, Canada. In addition to routine hospital tests, detailed neurological examinations, as well as electroencephalograms, audiograms, visual field determinations, blood cytogenetic studies, electromygram and nerve conduction studies, and blood and hair mercury level determinations were carried out. Here again, no significant clinical findings suggestive of organic mercury excess were detected.

4.

Board, Leonard, M. "Problems and priorities in combating air, water, and soil pollution in developing countries." Archives of Environmental Health, vol. #18 (2): pages 260-264 (1965).

The author provides impressions of the extent of air, water, and soil pollution problems in developing countries, focusing primarily on the urban areas. The state of liquid and solid waste disposal systems in cities of Central and South America, Asia, and Africa are discussed. Obstacles to the development of control programs are presented. Basic considerations in the provision of sanitary works include: the effects of imported materials and equipment on finance, effects on local industry of using local materials and equipment, effects on plant reliability, availability of construction and operating personnel, training of personnel, effects of financing policies on design, effects of state development, and uncertainty due to lack of data. This paper presents an extensive analysis of problems encountered in managing pollution in developing countries.

5.

Boulding, R., "What is pure coal?" Environment, Vol. #18(1): page 12 (1976).

The high environmental costs associated with increasing coal production are reviewed with regard to the contamination of surface and ground waters by sulfuric acid and increases in the acidity of rainfall on account of sulfuric emissions from coal fired power plants. Techniques for the measurement of coal quality are discussed for the parameters of heat content, sulfur, ash, and toxic trace elements. This analysis states that quantities released into the environment of potentially hazardous elements are significant.

6.

Branquinho, C.L. and Robinson, V.J. "Some aspects of lead pollution in Rio de Janeiro." Environmental Pollution, vol. #10 (4): pages 287-292 (1976).

Lead concentration in drinking water and air were measured. Houses with Pb inlet pipes had Pb concentrations in water of between 30 and 1,000 ug/l, with a mean of about 100 ug/l. Average annual concentrations of airborne Pb at 6 different collecting sites varied from 0.3 to 1.7 ug/m^3. Persons who live in homes with Pb pipes, and who live near the center of the city or along heavily traveled streets, are exposed to much higher than average Pb doses.

7.

Buck, A.A., Anderson, R. I., Kawata, K., Abrahams, I. W., Ward, R. A. and Susuki, T. T. Health and Disease in *Rural Afghanistan*, Baltimore: York Press, 1972.

This book provides a general description of the culture and community life in certain rural villages in Afghanistan. One section describes the general environmental health status. Of major concern are water supply, excreta disposal, solid waste disposal, sanitary housing, personal hygiene and vector control All of these areas are described as highly inadequate. This is a background document providing the status of environmental health. No attempts are made to provide solutions.

8.

Buck, A. A., Anderson, R. I., Sasaki, T. T., and Kawata, K. *Health and Disease in Chad; Epidemiology, Culture, and Environment in Five Villages*, Baltimore: The Johns Hopkins Press, 1970.

This text includes an extensive study of health in five communities in Chad. The environmental health is evaluated with respect to water supply, excreta disposal, refuse, vectors, housing, personal hygiene and food sanitation. The interdependencies of various social, cultural and health components of their lives are elucidated. The environmental health status of the specific rural villages is described. Suggestions for improvement of the situation are not provided.

9.

Buck, A., et al. *Health and Disease in Four Peruvian Villages. Contrasts in Epidemiology*, Baltimore: Johns Hopkins Press, 1968.

This is the first of a series of studies of tropical countries published by the Geographical Epidemiology Unit of Johns Hopkins University. The importance and the difficulties of undertaking epidemiological studies in tropical countries are discussed by the authors. In Peru they selected four geographically and culturally distinct villages as a basis for the comparison of environmental and health conditions. Successive chapters deal with family, social, economic circumstances, housing, education, and medical care, sanitary conditions, water supplies and the disposal of excreta, entomological data, infectious disease prevalence and epidemiological features, and nutrition. The comprehensive nature of the data makes this an excellent source book for studying general environmental health in a developing tropical country of the New World.

10.

Burger, E. J. "The environment and the protection of human health." In: *Recent Advances in Assessment of the Health Effects of Environmental Pollution, International Symposium*. Paris, France: World Health Organization, 1974.

Study of the effects on human health of environmental agents derives its importance because it affords the opportunity for prevention of disease and disability. Environmental health research provides the knowledge base for governmental decisions aimed at avoidance of undesirable or hazardous exposures. A very large universe of chemical and physical environmental agents, both products and by-products of man's endeavors, are treated in this manner. The list extends from the therapeutic drugs and pest control agents to air and water pollutants emanating from industrial effluents.

11.

Burke, J. and McMahon, B. "Analysis of food for residues of pesticides." International Conference on Environmental Sensing and Assessment: Vol. #1. New York: Institute of Electrical and Electronics Engineers, 1976.

Multiresidue analyses for monitoring and regulatory surveillance using programs and methods of the FDA are described. Emphasis is on methods for analysis of organochlorine and organophosphorus insecticides, their applicability to various sample types, scope, and requirements for analytical methodology in a regulatory program. Important considerations necessary for reliable residue analyses are covered in relation to the unit operations -- extraction, cleanup, determination, and confirmation of residue identity.

12.

Cappon, Daniel. "Priorities in environmental health, Part 1." International Journal of Environmental Studies, vol. #7 (2): pages 93-101 (1975).

The purpose of the inventory is to present a comprehensive range of environments analyzed in terms of their hazard to three levels of health, namely fitness, health itself and illness (both physical and mental). Part 1 outlines the conceptual design of the inventory and examines the first categories of health impediments titled Man as Primary Pathogen. Part 2 deals with the two remaining categories of environmental health hazards.

13.

Cappon. Daniel. "Priorities in environmental health, Part 2." International Journal of Environmental Studies, vol. #7 (3): pages 177-182 (1975).

Continuing the format of the inventory, as introduced in Part 1 (of Priorities in Environmental Health) Part 2 lists the two remaining categories of environmental health hazards. The first category involves man's indirect role as the transmitter of the impediment. The second category concerns hazards which occur when man is neither the aetiological agent or the transmitter.

14.

Carnes, R. A., Brunner, D.R., Landreth, R. E. and Roulier, M.H., "Land disposal of wastes: Potential for groundwater pollution." International Conference on Environmental Sensing and Assessment, Vol. #1, New York: Institute of Electrical and Electronic Engineers (1976).

Certain geographical areas are more susceptible than others to groundwater contamination. If a land disposal activity is placed over or near a groundwater table, there is a real threat that the latter will become polluted. Regional considerations, EPA research activities, legislative action, and monitoring are reviewed.

15.

Chang, T. T. and Chen, K. P. "A field survey on home environmental sanitation in two districts of Kaohiung City, Taiwan." Journal of Formosan Medicine, vol. #74 (4): pages 302-309 (1975).

Two districts, one residential, one industrial, are evaluated in terms of environmental sanitation. Looked at are such factors as water source and means of getting water, existence of and types of toilets or other facilities, methods of garbage disposal, types of fuel used, existence of insect and rodent pests and control measures against them (especially in housing practices), general housing practices, roads, sewers, and air pollution. This is a survey of the existing environmental health conditions in a particular area useful as background information on Taiwan.

16.

Chanlett, Emil T. Environmental Protection, McGraw-Hill Book Company, 1973.

The principles of environmental protection and resource management are emphasized. Those environmental factors to be managed include natural waters, excreta and wastewaters, solid wastes, air, commensal insects and rodents food, and all other factors causing impairment of health. The consequences of mismanagement of the environment are examined on three levels: effects on health; effects on comfort, convenience, efficiency, and esthetics; and effects on the balances of ecosystems and of renewable resources. The objectives of design and practice are presented without detailing methodologies. The principles included in this text may be useful as a theoretical background although no emphasis is placed on the developing countries.

17.

David, O. J. "The association between lower level lead concentrations and hyperactivity in children." In: Recent Advances in Assessment of the Health Effects of Environmental Pollution, International Symposium. Paris, France: World Health Organization, 1974.

Hyperactive children were compared with a non-hyperactive control group on two measures that reflect the presence of body lead and on a lead exposure questionnaire. The overall hypothesis that was tested, was that a relationship exists between hyperactivity in children and a concommitant condition of increased body lead stores. Operationally, the hypothesis was reduced to a comparison of the hyperactive group and control group on the following measures: (1) Blood lead levels; (2) Post penicillamine urine lead levels; (3) Scores on a lead exposure questionnaire. The designation hyperactive or non-hyperactive was arrived at by using 3 different measurements: (a) A doctor's diagnosis; (b) A teacher's rating scale; (c) A parent questionnaire. Hyperactive children had significantly higher values on all three measures than did the controls. More than half the hyperactive children had blood-lead levels in the range considered to be raised but not "toxic" and 60% of post-penicillamine urine levels were in the "toxic" range. It is concluded that there is an association between hyperactivity and raised lead levels, that a large body-lead burden may exact consequences that have been hither to unrealised; that the definition of what is a toxic level for blood-lead needs re-evaluation and that physicians should look for raised lead levels in children with hyperactivity.

18.

Eason Jr., John C. and Board, Leonard M. "Environmental health in tropical Africa." Journal of the National Medical Association. vol. #59 (4): pages 254-259 (1967).

The authors characterize the continent of Africa south of the Sahara as essentially a rural continent and claim that environmental health in this area means basic rural sanitation. The health hazards encountered by the people are those related to their quest for the essentials of life -- water, food, and shelter. The conditions of water, wastewater and solid waste systems are described for the majority of tropical Africa. The problems of obtaining abundant and adequate food and maintaining its quality are discussed. Sanitation in the home and the difficulties in its maintenance are discussed. Shelter and clothing and their relationship to disease are examined. This paper provides a discussion of existent environmental health programs and personnel. This article provides background on the status of environmental health in tropical Africa and proposes that the planner approach all African communities as rural in character, regardless of size.

19.

Evang, Karl, The Politics of Developing a National Health Policy, International Journal of Health Services, Vol. 3, No. 3, 1973.

Since national health policy is developed through the political instruments and modalities of a given country, it would be unrealistic to prescribe a solution applicable everywhere. Health matters are 'in' in the political world, due partly to the rapidly rising cost of medical care and related social services, and partly to pressure groups which have become aware of the potentialities of health services in the population. Also, the 'man-consuming' sector of society, industry and war machines, can use man as he is produced by nature only to a limited extent; more must, therefore be invested in his health. The emergency period in health protection and promotion is over in the richer parts of the world. However, few countries have yet produced a national health policy. The difficulties encountered in this process are discussed, and it is suggested that a great deal can be learned from the initiative, in the 1920's, of a recommendation by the Health Section of the League of Nations that every country develop a national food policy. It is argued that it is time for the World Health Organization to urge its member states to develop and introduce a national health policy.

20.

Gardner, E.D. "Animal models for human disease." In: Recent Advances in Assessment of the Health Effects of Environmental Pollution, International Symposium. Paris, France: World Health Organization, 1974.

Epidemiology and animal toxicology together yield health effects data which provide the guidelines for formulation of reasonable air quality standards. Epidemiologic studies suggest human health effects of pollutants in the ambient air. Community studies must cope with a host of complex covariates, are restricted to a limited range of exposures, and often provide information too late for preventive measures. Toxicology studies provide the opportunity to control some covariates, to utilize a wide range of pollutant exposures, to isolate the effects of individual pollutants, and to predict potential hazards. These two disciplines complement one another in providing information suggesting the possibility of cause and effect relationship which can then be used to set standards. This session will be directed toward the description, characterization, and evaluation of currently available whole animal models which have been or could be used as a biological indicator of adverse human health effects.

21.

Goldberg, A. M., and Silbergeld, E.K. "Low level lead toxicity." In: Recent Advances in Assessment of the Health Effects of Environmental Pollution, International Symposium. Paris, France: World Health Organization, 1974.

Lead poisoning in children is associated with several serious pathological and behavioral deficits. Studies in adult animals have been unable to support the association between lead intoxication and behavioral dysfunction. However, when suckling mice are exposed to lead from birth they exhibit an increase in spontaneous motor activity. In this study, mice were exposed to lead acetate from birth indirectly through their mothers' milk and then directly after weaning in their drinking water. Concentrations of lead acetate in the drinking water of 5 mg/ml and as low as 2 mg/ml produced behavioral disorders. At this dose of lead no classical overt signs associated with lead toxicity were seen in either the offspring or the mothers. Cerebral edema and histopathology were not observed in any of the offspring. However, growth of the offspring was decreased 10%. Spontaneous motor activity was measured from 30 to 150 days of age. The lead intoxicated mice were more than three times as active as coetaneous controls. A number of drugs used in the treatment and diagnosis of minimal brain dysfunction hyperactivity (MBD) in children were tested in these animals. The compounds chosen either decrease the hyperactivity in children (amphetamines, methylphenidates and Deane (R) or in the case of phenobarbital, exacerbate the symptomotology. In control animals in this study, these drugs acted in the expected manner. In the lead-intoxicated mice, these same compounds acted as they do in MBD hyperactivity. In order to understand the basic mechanisms underlying this lead-induced behavioral deficit, a combined pharmacological and neurochemical approach has been used. The data are supportive of a defect in the interactions of cholinergic and dopaminergic function. The model described has sufficient parallels to the clinical description of minimal brain dysfunction hyperactivity to make it a useful model to study the biochemical mechanisms in both lead toxicity as well as hyperactivity. Additionally, this study emphasizes the need for the administration of potentially toxic compounds during the critical stages of neurological development in order to assess the impact of these compounds in the human.

22.

Goldman, J. C. and Ryther, J. H. "Waste reclamation in an integrated food chain system." In: (eds) Tourbier, J. and Pierson Jr., R. W. Biological Control of Water Pollution, pages 197-214, Philadelphia, Pennsylvania: University of Pennsylvania Press, 1976.

The nonuse of the fertilizing potential of waste materials for food production is extremely inefficient. The alternatives to traditional agriculture include a partial replacement of chemical fertilizers by human and animal wastes, and the use of photosynthetic algae to assimilate the nutrients of wastewaters. Controlled eutrophication and the status of mariculture are discussed. Laboratory and pilot-scale experimentation established that a mixture of secondary sewage effluent and seawater is an effective medium for the growth of the common marine phytoplankton. Properly balanced compositions of phytoplankton, crustaceans, mollusks, and seaweed were capable of removing 95%-100% of the N. The design and function of N-stripping aquiculture systems are discussed, and marine organisms that may be adaptable to mariculture systems are surveyed. Mariculture is limited to coastal zones, but 1/3 of the U. S. population lives in these zones. These waste recycling schemes have the potential to conserve large quantities of energy presently committed to the manufacture of chemical fertilizer. Pesticide use would also be greatly reduced. Coupled with the waste heat from power plants, mariculture might be adaptable to all-season operation in the North. The bioaccumulation of pathogens, metals, and refractory organics would necessitate the interpolation of purification steps at some points in the aquiculture scheme.

23.

Gracey, M., Stone, D. E., Sutoto and Sutejo. Environmental pollution and diarrheal disease in Jakarta, Indonesia. Journal of Tropical Pediatrics and Environmental Child Health, Vol. #22 (1): page 18 (1976).

A relationship was proposed between the high bacterial contamination of water surfaces in and around General Hospital in Jakarta and the high prevalence of gastro-intestinal disease in children. Sanitary preventive measures are required for prevention.

24.

Groth, E. "Increasing the harvest," Environment 17: pages 28-39, (1975).

Global grain reserves are at their lowest point in nearly two decades, and bad weather, fertilizer shortages, or other unfavorable developments could push some of the perennially hungry nations over the brink into famine within the next few years. In this situation, the bountiful food production capacity of North America is a resource of vital importance, not only to Americans, but to many of the world's undernourished peoples, as well. This article takes a broad look at the environmental consequences of food production in the U. S. and at the options available to make changes that will enhance the quality of the environment. Discussed are: water, energy, pest control, fertilizer, soil depletion, livestock wastes, crop residues, food processing wastes, threats to ecological stability, new directions, and the current world situation. This paper is not directly useful to the developing nations.

25.

Grushka, T., Ed. Health Services in Israel; A Ten Year Survey, 1948-1958, pages 11-25, Jerusalem: The Ministry of Health, 1959.

This book discusses all aspects of the Israeli health services as they were developed during the years 1948 to 1958. The section evaluated here provides a complete description of the establishment of Israel's environmental sanitation program including major emphases, procedures used, and administrative and personnel functions. The organizational structure and techniques used may be useful as only one of many alternative approaches.

26.

Hanlon, John Jr. "Public, occupational and environmental health." In: (Ed) Ray, Charles D., Medical Engineering, pages 796-816, Chicago, Year Book Medical Publishers, Inc. 1974.

This paper describes the interrelationships and interdependencies between the public health, environmental health, and occupational health fields. The scope of public health is defined. Organizational needs, on both a governmental and non-governmental level are discussed. Industrial or occupational health is defined and a brief synopsis of hazards associated with occupational exposures is provided. Included also are benefits to be gained by the development of occupational health programs and the role of government in the occupational health scheme. Environmental health is described and a brief discussion of certain pertinent areas is provided. Those areas include air pollution, pesticides, waste, water, accidental injury and poisoning, radiation, and the potentiating effects between pollutants. A brief discussion is provided of research and program needs in the field. The final section of this paper presents lists and tables of some pertinent intervention technologies used in all of three health fields.

27.

Hardenbergh, W. A. and Rodie, E. R. Water Supply and Waste Disposal, Scranton, Penn.: International Textbook Company, 1961.

Source not referenced.

28.

Heidman, J. A. and Brunner, D. R. "Solid wastes and water quality." (Literature review). Journal of the Water Pollution Control Federation, vol. #48 (6): pages 1299-1305 (1976).

A review of literature dealing with the effect of solid waste disposal on water quality is presented. Topics covered include: factors affecting leachate formation and control, a numerical procedure for evaluating the environmental impact associated with land disposal, the use of earth resistivity surveys to define groundwater contamination, techniques for monitoring landfill sites, and the chemical characteristics of two leachate plumes. An evaluation is presented of combined disposal of waste water sludges and municipal refuse in a sanitary landfill, and the design of a facility for collection, treatment and disposal of leachate. This may be useful in assessing the impact of solid waste disposal on water quality in urban and rural areas.

29.

Heyneman, Donald, "Mis-aid to the Third World: Disease repercussions caused by ecological ignorance." Canadian Journal of Public Health, Vol. 62 (4): p. 303-313, (1971).

The mixed blessing of mammoth hydroelectric power projects in Africa is discussed in this article, with particular reference to spread of parasitic disease, chiefly schistosomiasis, and to other unforeseen ecological byproducts. The Aswan High Dam is a focus, chiefly because of its enormous size and importance, but the view is on man, his sweeping impact and the often unexpected repercussions. Three levels of ecological shock are described: environmental, cultural, and personal. This paper provides examples of the impact on health related to increasing levels of technology.

30.

Higgins, I. J. and Burns, R. G. The Chemistry and Microbiology of Pollution, London: Academic Press, Inc., 1975.

This book discusses the nature of certain groups of environmental pollutants. The groups are pesticides, sewage and fertilizers, hydrocarbons, surfactants, synthetic polymers, metals, and a group of miscellaneous pollutants. Chemical and biological properties, interactions in the environment, and analytical methods are considered for each group of compounds. The sections of primary relevance to the developing countries are those on pesticides, sewage, and fertilizers. The chemical (and biological) components are described, their significance and control technologies presented.

31.

Holdren, John P. and Ehrlich, Paul R. Global Ecology, Readings Toward a Rational Strategy for Man, Harcourt Brace Jovanovich, Inc., 1971.

This collection of essays discusses the interrelationships between population, resources, and environment. The major themes presented are: that "the enormous complexity of the problems we face, embracing a wealth of interconnections among human populations, manmade systems, and the often ill-understood natural systems on which all life depends; the second is the fundamentally radical changes in human institutions and behavior prerequisite to the global ecological strategy we need so desperately."

32.

Horvath, Donald J. "Trace elements and health." In: (ed) Newberne, Paul M. Trace Substances and Health, A Handbook, Part 1, New York: Marcel Dekker, Inc., 1976.

This paper provides a discussion of the health effects associated with a number of trace elements. Effects associated with both deficiences and excessive amounts are discussed and essential levels are mentioned. The elements addressed are iron, iodine, selenium, molybdenum, manganese, flourine, copper, nickel, chromium, cobalt, zinc, cadmium, mercury, lead and others.

33.

Jaag, O. "Present trends in research on water and sewage." In: Problems in Community Wastes Management, W.H.O., Public Health Paper No. 38, pages 54-60, Geneva: WHO, 1969.

This paper describes some of the trends in the development of processes for the protection of water and purification of sewage. Topics discussed include: evaluation of the degree of pollution of a body of water, causes and effects of eutrophication, techniques for nutrient removal, and treatment of sewage sludge.

34.

Jennings, James H. Shipman, Harold R., Warford, Jeremy J., Bierstein, Paul, et al, Guidelines for Sector Work in the Water Supply and Waste Disposal Sector, International Bank for Reconstruction and Development, Public Utilities Department Guidelines Series, 1973.

These guidelines suggest the means for acquiring the information about the water supply and waste disposal sector needed in order to prepare plans for its development. Sector studies are primarily for the benefit of decision makers at the national and local level, but they also benefit outside agencies interested in efficient development of the sector. To be effective, sector work must involve both appropriate officials and the sector specialists in the country in question, and be seen as part of a continuous process for building up knowledge and improving decisions in the sector. Several typical sector issues are discussed, along with a number of practical considerations for organizing sector work. Detailed planning of sector work is emphasized. Annexes provide, among other things, checklists which help to assure that important aspects are not overlooked.

35.

Johns, Lucy, Chapman, Thomas, and Raphael, Morton. Guide to Financial Analysis and Introduction to Economic Impact Analysis for Health Planning, U. S. Department of Health, Education, and Welfare. Public Health Service. Health Resources Administration. Bureau of Health Planning and Resources Development. Division of Planning Methods and Technology. National Health Planning Information Center. DHEW Publication No. (HRA) 76-14513, June, 1976.

This third publication in the Health Planning Methods and Technology series "is a guide for health care planners for performing economic and financial analysis of health care service projects." The guide presents basic concepts and theories in health economics and institutional finance. It offers to planning agency staff, review committee members, and agency board members an approach for reviewing the financial feasibility of health service projects. The concept of economic impact analysis is also introduced.

36.

Kamal, A. M. "Problems of communicable diseases and their control in developing countries." Journal of the Egyptian Public Health Association, vol. #47 (1): pages 1-24 (1972).

This paper discusses problems involved in communicable disease control in developing countries. Factors addressed include geography, culture, manpower, nutritional disorders, sanitation and socioeconomic factors.

37.

Karlin, Barry. "The state of the art of delivering low cost health services in less developed countries: A summary study of 180 health projects." American Public Health Association, International Health Programs, Washington, D.C., January, 1977.

The first chapter of this report includes definitions and a description of the conceptual framework and limitations of the report. Chapter two describes project activities, characteristics and obstacles. Health manpower training and utilization are discussed in the third chapter and the delivery of health services is discussed and elaborated in the fourth. The fifth topic is the promotion of health: education, organizations, and the environment. Project planning and management, evaluation, and innovations in the delivery of low-cost health services are discussed in the last three chapters.

38.

Karlen, D. L., Vitosh, M. L. and Kunze, R. J. "Irrigation of corn with simulated municipal sewage effluent." Journal of Environmental Quality, vol #5 (3): pages 269-273 (1976).

A field study was conducted to evaluate the effects of applying 25, 50, 100, and 200 cm of simulated municipal sewage effluent to corn grown on a tile-drained loam soil. A soil-water balance was determined by measuring rainfall, irrigation, evapotranspiration, and tile flow. Deep percolation losses were estimated by difference. Effects of the loadings were determined by measuring corn silage and grain yields. Silage yields were greatest at the 50-cm loading, but grain yields were greatest at the 200- and 100-cm rates in 1973 and 1974, repectively. The fate of applied nutrients was determined by measuring losses through drainage water, uptake by the corn, and changes within the soil profile. Losses and uptake of N, K, P, and Na are presented.

39.

Kinnison, R. R. "Pb: In search of the facts." Environmental Science and Technology, vol. #10 (7): pages 644-649 (1976).

The biological impact of Pb, its environmental transport to man, and its effect on man is overviewed by listing various review projects, symposia, periodicals, and other sources of information. Also included are the following information sources on Pb by topic: environmental transport and occurrence, Pb in plants and soils, human exposure to Pb, deposition and storage of Pb in tissues, effects of Pb on body chemistry, Pb metabolism and kinetics, species-specific effects, treatment and clinical toxicity, seasonal and geographic variations, and synergism and potentiation of the toxicity.

40.

Kirov, N.Y., "Lessen the industrial growing pains of developing countries by more effective aid." Ciba Foundation Symposium, 32, p. 31-48, 1975.

This paper discusses the association between industrial development and the environment and the inevitable problems associated with industrialization from increased population, urbanization, transportation, lack of planning, and ignorance. The author states that these may lead to health hazards but that the trade-off is gladly made by most cultures in exchange for an extra 20 years of life (approximately). Specific health hazards associated with industrial development are discussed and examples are provided from Taiwan, Saigon and Korea. An approach to providing more effective aid to developing nations is proposed.

41.

Knight, R. "The pattern of infective disease in developing countries in relation to environmental factors." In: (Ed) Howe, G. Melvyn and Loraine, John A. Environmental Medicine, pages 119-127, London: William Heinemann Medical Books Limited, 1971.

This paper breifly outlines some of the major environmental problems existing in most developing nations today and relates these factors to disease conditions. The author proposes an ecological approach to infective disease. Soonotic infections, their evolution and importance, are discussed. Direct

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effects of the environment (climatic, geographical and vegetational) on disease transmission are described specifically for zoonotic reservoirs, intermediate hosts and vectors and for free living facultative parasites. Also addressed are the effects of environmental factors caused by human beings primarily. Those factors are classified as either economic, nutritional, or cultural. The consequences of progress in developing countries are discussed with particular emphasis on agricultural development and urbanization.

42.

Kriesberg, Harriet M., Wee, John, Hollander, Edward D., and Bon, Joan. Methodological Approaches for Determining Health Manpower Supply and Requirements (2 volumes) U. S. Department of Health, Education, and Welfare. Public Health Service. Bureau of Health Planning and Resources Development. Division of Planning Methods and Technology. National Health Planning Information Center. DHEW Publication No. (HRA) 76-14512.

This second publication in the Health Planning Methods and Technology series describes and evaluates various methods used to determine present and future health manpower supply and requirements. This monograph does not address the full range of methodologies that may be used in overall health manpower planning; rather, it is limited to the specific subject of estimating manpower supply and requirements. It deals only peripherally with related manpower issues that affect supply and requirements, such as labor productivity, task delegation, and geographic and specialty distribution.

43.

Kupchik, G. J. and Franz, G. J. "Solid waste, air pollution and health." Journal of the Air Pollution Control Association, vol. #26 (2): pages 116-122 (1976).

This article attempts to clarify the direct and indirect associations between the incidence of air pollutant-related disease, the emission of air pollutants, and solid waste generation and disposal. A survey of the pertinent literature is provided and the contribution of solid wastes to air pollution is discussed. Finally, the value of solid waste disposal technologies in diminishing the adverse impact of disposal is presented. This paper does not discuss conditions existing in developing nations although the principles may be applicable to most countries with a solid waste problem.

44.

Mahler, H. "Health strategies in a changing world." WHO Chronicle, Vol. #29: pages 209-218 (1975).

Improvements in communications, new managerial concepts, and changing health needs in both developed and developing countries have led to a reappraisal of the role and activities of WHO in recent years. During 1974, the urgency of this reappraisal and the need for more rational systems of health care were

64

heightened by the socioeconomic uncertainty prevailing in many countries. In the introduction to his annual report to the World Health Assembly and to the United Nations for 1974, Dr. H. Mahler, Director-General of WHO, gives a broad survey of health priorities in the world today and outlines some of the new approaches that have emerged in the field of international public health.

45.

Masironi, Miesch, A. T., Crawford, M.D., and Hamilton, E. I., Geochemical environments, trace elements, and cardiovascular diseases. Bulletin in the World Health Organization, Vol. #47: pages 139-150 (1972).

Cardiovascular diseases are often found to be associated with certain physiochemical characteristics of the environment -- namely, the hardness of the water and the types of rock and soil underlying the area. Areas supplied with soft water usually have higher cardiovascular death rates than do areas supplied with hard water. Evidence linking cardiovascular diseases with the geochemistry of rocks and soils is more limited. The nature of these associations is still speculative but it is possible that certain trace elements are involved, some being beneficial and others harmful. Further epidemiological studies to identify these various trace elements are desirable.

46.

Mata, L. J. "The environment of the malnourished child." Basic Life Science 7: pages 45-66 (1976).

"My objective has been to stress, within the whole environment, the importance of infection and the need to diminish it. Ways to control and prevent infection and the need to diminish it. Ways to control and prevent infection are readily known. They have to do with education of the population to improve personal and environmental hygiene. Economic investment is necessary to improve housing and water supply systems, waste disposal, and such preventive measures as immunization programs. Although such measures may appear expensive when first implemented, they have long-lasting effects and may require minimal expenditure once they are established. Large segments of the population stand to benefit, and other development interventions can then be introduced. However, these measures should not be implemented singly. They should be accompanied by community development, family planning, social legislation -- in other words, the holistic approach to health and welfare. To do otherwise may aggravate the problem by stimulating demographic growth, perpetuating malnutrition and infection, and maintaining underdevelopment."

47.

McKinney, Ross E. Microbiology for Sanitary Engineers, New York: McGraw-Hill Book Company, 1962.

Source not referenced.

48.

Miller, M. J., Industrialization, ecology and health in the tropics. Canadian Journal of Public Health 64 (suppl): 11-16 (1973).

The introduction of modern technology into developing countries is a mixed blessing. Industrialization, introduction of cash crops, and the building of dams in rural areas disturb the balance of nature. Diseases previously absent in some areas such as schistosomiasis and malaria are introduced by the movement of people and the changes in ecology. Migration of people from rural to urban areas is a consequence of industrialization. Overcrowding in the cities makes possible the spread of infectious diseases and introduces the problem of pollution.

The author provides examples of the effects of industrialization and technology on the environment and thereby on the health of human beings. The conditions described, although specifically related to the tropical developing countries, apply also, in a broad sense, to most other developing nations as well.

49.

Morris, R. C. The Planning Problem. In: U. S. Public Health Service, Bureau of States Services, Urban Planning for Environmental Health; Course Manual, Cincinnati, pages II-1-1, 1962.

Provides a step-by-step outline of the planning process including data collection and evaluation, goal and policy formation, formulation of the means to accomplish goals, and a proposed program of action. The outline then describes the roles of planning agencies as supporting as well as coordinating in environmental health planning. This paper integrates principles of planning with the emphases of environmental health and may be useful as such. It is geared primarily towards urban planning in developed countries.

50.

Morris, S. C. and Novak, E. W. "Environmental health impact assessment." American Society of Civil Engineers. Environmental Engineering Division. Journal, vol. #102 (3): pages 549-554 (1976).

A methodological approach is presented with the following steps: identification of the initial perturbations in the environment; tracing perturbations through the environment to determine the magnitude and duration of the exposure to the receptor population; identification of the receptor population and its high risk subgroups; and estimation of these impacts by applying derived exposure-response functions. The 4-step analysis is outlined along with a discussion of human response to environmental agents. The uncertainty and reversibility of a given stressor and its impact on health is also presented.

51.

Navia, J. M., Hunt, C. E., First, F. B., and Narkates, A. J. "Fluoride metabolism - effect of preeruptive or posteruptive fluoride administration on rat caries susceptibility." In: (Eds) Prasad, Ananda S. and Oberleas, Donald. Trace Elements in Human Health and Disease, vol #11, New York: Academic Press, Inc., 1976.

The results of this study suggest that administration of supplemental fluoride is most effective in preventing dental caries when a tooth is erupting or has recently erupted. Water fluoridation and topical administration of fluoride are recommended as ideal approaches for maximal dental health.

52.

Neddle, B. and Garland, G. "Dumps: A potential threat to ground water supply." Water Well Journal, vol. #24 (1): pages 83-87, 1975.

The process by which leachate is produced is described. Initially, the solid waste acts as a sponge and simply absorbs the water. However, with continued water addition, the waste eventually reaches the limit of its moisture retaining capacity. At this point, any further water entering the waste will cause an equal volume of leachate to leave the waste. The process is greatly accelerated at open dumps where soil cover is not provided because runoff is greatly reduced, thereby increasing infiltration and leachate production. Liquid waste disposal contributes to the water going through the system as well as waters from adjacent areas and groundwater moving through the waste.

53.

Phoon, W. O. "The impact of industrial growth on health in Southeast Asia." Ciba Foundation Symposium 32, p. 107-126, 1975.

The author discusses some problems involved with growing industrialization and stresses that it is difficult to extrapolate from experiences of other regions due to climatic, cultural and even genetic differences. Some specific occupational hazards are enumerated for a number of the South East Asian countries such as silicosis, lead poisoning, pesticide poisoning and accidents leading to death or paralysis. Singapore is evaluated as an example of the most industrialized country in the region. This paper provides some insight into the health hazards related to industrialization in the developing nations of South East Asia. Technology or policy programs are not provided.

54.

Pisharoti, K. A. Guide to the Integration of Health Education in Environmental Health Programmes, Geneva: WHO, 1975.

This article is presented as a stimulus to the incorporation of health education into environmental health programs. The primary topics discussed in this publication are the importance and integration of health education in environmental health; training and supervision needs, objectives, and methods; and environmental health education in schools. The utility of this guide may be in providing a basic understanding of methods and processes relating to health education. It is not a training manual.

55.

Paulsen, E. "The concept of estimation of an acceptable daily intake for man of food additives and pesticides." In: Recent Advances in Assessment of the Health Effects of Environmental Pollution, International Symposium. Paris, France: World Health Organization, 1974.

In the assessment of the health effects in man of pesticides and food additives by far the best information would be obtained from investigations in man. There may however, be serious ethical and legal problems in connection with investigations designed to establish safety or to detect toxicity in man. Useful information may sometimes be derived from studies on persons who are occupationally exposed to the chemical or who have been accidentally poisoned by it. In some cases the exposed population may be large enough and sufficiently well defined to render appropriate epidemiological studies worthwhile. In most cases, at present, the assessment of the health effects and the safety for man of exposure to food additives and pesticides must be based on results of animal experiments. As the major route of exposure for the general population to these chemicals is through food an assessment of the significance for health is based on the intake via food and drinking water.

56.

Preda, N. "Pollution of the environment by nitrates and nitrites and the possibility of the formation of nitrosamines." In: Recent Advances in Assessment of the Health Effects of Environmental Pollution, International Symposium. Paris, France: World Health Organization, 1974.

Studies on agricultural products contaminated with nitrates have shown that the process of digestion in the animal stomach transforms nitrates into nitrites, which, when combined with the existing secondary and tertiary amines, give rise to nitrosamines, known for their carcinogenic potential. During experiments we have demonstrated the formation of nitrosamines in the stomach of Wistar rats receiving a nitrate-rich diet. Nitrates and nitrites (known for their methemoglobin action) are used as preservatives in a number of industrialized food processes. Subsequently, under the conditions which develop within the treated foods and also within the stomach, these inorganic substances promote the formation of nitrosamines. Using standard techniques, we have demonstrated the presence of nitrites in various food products treated with nitrates and nitrites, at the levels ranging from 0.6 mg% to 10 mg%, depending on which of the two chemicals was used, the duration of maturation, and the temperature at which the product was stored. In order to avoid, at least to some extent, the risk of contamination of food products by nitrosamines, the legislative standards in force in our country impose an upper limit of 7 mg% on nitrites in agricultural food products, i.e. half the level acceptable under FAO-WHO regulations and regulations in force in other countries.

57.

Purdom, P. W. (Ed) Environmental Health, New York: Academic Press, Inc., 1971.

This general text of environmental health provides a scope of the field and basic information geared towards Western, developed nations. A section on disease vectors discussed the identification and control of vectors and the diseases they transmit. Food sanitation is described with types of problems encountered, control measures, and methods of handling food industry wastes. Water and wastewater for both industrial and domestic use and elimination are discussed and methods of surveillance, testing and treatment are presented. Types of pollutants, methods of surveillance, testing, treatment and disposal are explained and evaluated for solid waste and air pollution. Also included are sections on ionizing radiation, housing, occupational health, accident prevention, and environmental planning and management. This last section provides information on program planning including needs, priorities, objectives, resources and plan of action, budgets, and evaluation. Additionally statistical evaluation is discussed; systems for planning and organization of public efforts for environmental control. This text provides the basic principles and technologies of environmental health with an emphasis on theory. In the planning and management section, socio-cultural factors are discussed in relation to health planning although the specific concerns of developing nations are not emphasized. Comparative costs, manpower demands, facility needs for different methods and technologies are discussed.

58.

Rajagopalan, S. and Shiffman, M. A., Guide to Simple Sanitary Measures for the Control of Enteric Diseases, Geneva, WHO, 1974.

This publication provides a compilation of simple sanitary measures for the control of enteric diseases. These measures relate to water supply systems, wastes collection and disposal, food sanitation, institutional and camp sanitation, training of personnel, and actions in an emergency. The methods provided for disease control in water supply systems include urban and rural supplies and the disinfection of water. Wastes collection and disposal methods include those used for human excreta, community liquid wastes, and solid wastes. This publication may be quite useful to the developing countries in providing basic, inexpensive control methodologies for their most serious health problems. It is intended for use by professional public health personnel in developing countries.

59.

Sawyer, Clair N. and McCarty, Perry L. Chemistry for Sanitary Engineers. New York: McGraw-Hill Book Company, 1976.

The first 10 chapters are concerned with fundamentals of chemistry for engineers, each summarizing a particular area of chemistry with emphasis on sanitary engineering application. Many schools now give a lecture course on chemical principles, and it is felt that the chapters on organic chemistry, physical chemistry, colloid chemistry, biochemistry, and radiochemistry are particularly suited for such a course. The remaining chapters in this part of the book on qualitative chemistry, quantitative chemistry, and instrumental analysis, together with the 24 chapters in the second part of the book, are most useful as lecture material to be used along with a laboratory course on water and wastewater analysis. The latter part of the book is concerned with various water and wastewater analyses of particular value to sanitary engineers. These chapters are written to stress the basic chemistry of each analysis and to point out their significance in sanitary engineering practice. They should be particularly useful if used together with "Standard Methods for the Examination of Water and Wastewater," published by the American Public Health Association, which gives the details for carrying out each analytical determination.

60.

Schaefer, Morris. Administration of Environmental Health Programmes. A Systems View. Geneva: WHO, 1974.

This volume first discusses the evolution of neoclassical administrative theory; its advantages and disadvantages. The concepts of general systems theory as applied to administration are elaborated. A systems approach to environmental health is proposed with a discussion of the applicability of the systems approach, environmental health relationships, and problems, environmental health interventions, time and distance factors, and implications of a systems view of environmental health. The administrative process in environmental health is discussed including the following: An overview of the administrative process; planning, decision making, and evaluation; program planning; management planning, design and implementation; management operations, communication and information; management operations, system control and evaluation; and prospects for administrative and technological development in environmental health programs.

61.

Schliessmann, D. J. "Diarrhoeal disease and the environment." Bulletin of the World Health Organization. Vol. #21: pages 381-386 (1959).

The findings of Schliessmann et al. are supplemented by additional data from Guatemala, California, and Georgia, and the respective importance of the various factors concerned in the spread of diarrhoeal diseases is discussed. In comparison with typhoid and cholera, evidence of the precise role of safe water supplies in the control of other diarrhoeal diseases is less certain, although the improvement of a supply, together with the environmental consequences associated with it, usually results in reduced diarrhoeal morbidity. Shigella organisms usually die off rapidly in water, but the importance of personal hygiene has been demonstrated by a number of authors, and a close relationship has been found between diarrhoeal morbidity rates and the amount or accessibility of water for washing. Similarly relationships have been demonstrated between Shigella and Ascaris prevalence rates and the type of toilet and excreta disposal facilities. A number of studies have shown that adequate control of flies can effect important reductions in Shigella infections. Schliessmann warns against unjustified generalizations which have been based on a report by Weir et al. In interpreting the findings of the latter report in which the authors had failed to find any improvement in infant mortality or crude death rates following the installation of a sanitary water supply and latrines in four villages, it is necessary to take into account the special circumstances and consequent limitations of the study.

62.

Schliessmann, D. J. et. al. "Relation of environmental factors to the occurrence of enteric diseases in areas of eastern Kentucky." Washington, D.C. U. S. Government Printing Office (Public Health Monograph, No. 54) 1958.

A survey of Kentucky mining villages was undertaken by the United States Public Health Service. The villages were classified according to quality of housing, sanitary disposal facilities and water supply, and the socioeconomic circumstances of the householders were also taken into account. Among the occupants the commonest pathogens were the shigelloses, the tapeworm (Ascaris lumbricoides), and the whipworm (Trichuris). A gradient in the incidence of these infections and in the acute diarrhea mortality rate was shown to exist, houses with indoor piped water and flush toilets having a low and those with only outdoor water and privies, a higher prevalence. The highest prevalence was in households whose water had to be obtained from a distant source. In the households with the worst sanitary facilities, 60% of facets examined from the five- to nine-year age group were positive for Ascaris and 57.3% for Trichuris. The importance of housefly infestation was not clearly demonstrated in this study, although earlier studies quoted by the authors showed that control of houseflies was associated with a reduction in diarrhoeal disease. Among socioeconomic factors, crowding, family size, and the educational status of the housewife were found to have an association with enteric disease prevalence.

63.

Scott, J. C., Health and Agriculture in China, London, 1952.

Described and evaluated are the health and agricultural aspects of composting using combined feces and urine ("night soil"). Topics discussed include the effect on health of reclamation of wastes by primitive and unsanitary methods, problems involved in collection and handling of fecal material, chemical losses with primitive methods of utilization, destruction of pathogens in aerobic vs. anaerobic decomposition, reclamation of nitrogen, fly control, effects of use of composted materials on crop yield, and the problem involved in integrating proper composting techniques into the scheme of individual farms or villages. This method may be useful in some agricultural areas of the world. The specific problems involved in integrating this technique into individual use in China may also be helpful, in a broad sense, for other nations.

64.

Sekaran, A. Sekaraja. "Environmental sanitation and pollution in Malaysia." Medical Journal of Malaysia, vol. #29 (2): pages 97-102 (1974).

The introductory section discusses pollution and environmental quality, proposed objectives and the present status in Malaysia in relation to those objectives. The second section discusses environmental quality control: the origin of the existing sanitation problems, pollution control and water resources, protection of community water supply sources, development of new water supply resources, and designation of beneficial water uses. The need for trained manpower is reviewed; the present situation and future training needs. Related supporting activities to environmental sanitation include epidemiology, analytical chemistry and biology services, and environmental studies and education.

65.

Senn, C. L. Syllabus in Environmental Health.

This publication provides an outline, with brief descriptions and definitions, of all areas of environmental health. Those areas included are: Water supply, wastewater, recreational waters, solid waste disposal, occupational health, air pollution control, lighting and noise, ionizing radiation, arthropod and rodent control, milk and food control, housing, and program administration. This text may be used only as a general outline of the field of environmental health with major priorities stressed. No specific technologies or information related to developing nations is included.

66.

Shuval, H. I. and Gruener, N. "Epidemiological and toxicological aspects of nitrates and nitrites in the environment." American Journal of Public Health, vol. #62 (8): pages 1045-1052 (1972).

This paper describes the relationship between nitrates and nitrites and health. The relationship of age to the effects and the types of exposure are discussed; primarily through food and water. Methemoglobinemia in infants exposed to nitrates is discussed.

67.

Siegmann, Athilia E., A Classification of Sociomedical Health Indicators: Perspectives for Health Administrators and Health Planners, International Journal of Health Services, Vol. 6, No. 3, 1976.

The conceptualization and operationalization of measures of health status are considered. Health indicators are conceived as a subset of social indicators, and therefor, as any social indicator, they are viewed as derivative from social issues. The interrelationships of different frames of reference for defining and measuring health that have accompanied three distinct health problem patterns in the United States are viewed from a developmental perspective. Mortality and morbidity rates, the traditional health indicators, by themselves no longer serve to assess health status in developed nations. Their deficiencies as indicators serve as background for a classification schema for sociomedical health status indicators that relates health definition frames of reference, measures of health status, and health problems. The role of a group of health indicators -- sociomedical health indicators -- in the current formulation of health status measures is assessed.

68.

Smith, Jack L. "Metabolism and toxicity of lead." In: (eds) Prasad, Ananda S. and Oberleas, Donald. Trace Elements in Human Health and Disease, pages 443-452, New York: Academic Press, Inc., 1976.

This paper discusses factors that may be involved in the increase in the lead burden in those children studied; low iron, low calcium, high levels of vitamin D and lead exposure, possibly due to dust and dirt as well as pica of paint and plaster.

69.

Sofoluwe, G. O. "Economic aspects of environmental quality -- economic potentialities and employment opportunities arising from improving environmental health in developing countries." International Conference on Environmental Health, Proceedings, Primosten, Yugoslavia, 1973.

The author describes the existing state of environmental health in Africa. Emphasized is the point that improving environmental health conditions will provide economic benefits. Examples, such as an increase in available jobs and stimulation of industry within the countries to produce sanitary equipment, are provided. Problems are discussed in relation to housing, water supply, sewage disposal, vector control, air pollution, food control and hygiene, noise pollution, ionizing radiation, the occupational environment, meteorology, and recreational health. Economic benefits of improving environmental quality are stressed along with promoting native industrial potential.

70.

Srivastava, P. K. "Acceptance of sanitary composting in rural areas." Indian Journal of Public Health, vol. #13 (1), pages 30-35 (1969).

This paper describes a study of the acceptance of sanitary composting in rural India. The composting method involves the use of standard compost pits and regular scaling of the pits with a layer of earth. This technique was taught to villagers who had previously been accustomed to open piling of refuse and excreta. The program involved imparting information on sanitary composting and on the flyborne diseases. Information was distributed verbally and with charts and diagrams. Meetings were held periodically and villagers were encouraged to describe their positive experiences with sanitary composting. Volunteers to construct pits were subsidized with bricks and cement. The study analyzes acceptors as either innovators, early or late adapters with respect to status, caste, literacy, land holding, amount of manure required, number of cattle in household, household size, and reasons for constructing the compost pits. It was found that the earliest acceptors were usually individuals of higher relative status while the later acceptors were generally of lower status. Reasons for acceptance of the technique were variable.

71.

Stewart, S. A. et al. "The relationship of certain environmental factors to the prevalence of *Shigella* infection. *American Journal of Tropical Medicine and Hygiene*, Vol. #4: pages 718-724 (1955).

The incidence of Shigella infection was studied in relation to water supply, sanitary disposal system, fly infestation and facilities for proliferation, physical housing structure, and aesthetic quality of the housing and its environment. The proportion of poor housing in the neighborhood, and the availability of water for personal hygiene, as well as the purity of the supply, were found to be important factors in influencing the prevalence of shigellosis.

72.

Struening Elmer L., Approaches to Evaluation: Social Area Analysis, *International Journal of Health Services*, Vol. 4, No. 3, 1974.

Modern social area analysis, as presented by Tryon and Bailey, offers a methodology for understanding the selective use of health services and for evaluating the effects of change introduced into health service delivery systems. Definitions of evaluation research are given in this paper, followed by a brief history and definition of social area analysis. Three types of evaluation studies -- descriptive, comparative or correlational, and experimental -- are described and exemplified. The role of epidemiologic data in describing catchment areas and in the identification and location of high-risk populations is discussed. Applications of multi-variate statistical procedures for identifying salient dimensions of defined areas and for developing equations linking area characteristics to rates of service use are described. It is concluded that applications of social area analysis methodology can make important contributions to the evaluation of health delivery systems serving catchment area populations.

73.

Summers, W. K. *Isotopes of water: A bibliography*. Ann Arbor, Michigan: Ann Arbor Science Publishers, 1976.

More than 2,300 references to the isotopes of water-H, ^{2}H, ^{3}H, ^{16}O, and ^{18}O are included. These represent 95% of the literature published through 1974, and should help scientists see aspects of isotope analysis and interpretation that need more work. With temperature-dependent water isotope ratios being used increasingly in the study of hydrologic systems and rock-water formations, this information should be useful to geologists, geochemists, hydrologists, meteorologists, climatologists, soil chemists, and physicists. Researchers interested in these isotopes can avoid much unnecessary literature sifting by utilizing this guide to pre-1975 literature.

74.

Sumner, J. "Regional approach to integrated wastes management planning." Problems in Community Wastes Management Planning. Public Health Paper No. 38, pages 47-60, Geneva: WHO, 1969.

Possibilities are outlined for dealing with liquid and solid wastes as an integrated system. The methods are designed for the inclusion of domestic and commercial liquid and solid wastes normally accepted in a sewage system. Methods of combined collection are suggested and related costs discussed. Treatment methods of the combined wastes and alternative methods of transport are discussed. Economic and technical drawbacks of the proposed integrated system are presented.

75.

Tabershaw, Irving R. and Gaffey, William R. "Mortality study of workers in the manufacture of vinyl chloride and its polymers." Journal of Occupational Medicine, vol. #16 (8): pages 509-518.

This historical prospective mortality study of 8,384 men who had at least one year of occupational exposure to vinyl chloride before December 31, 1972, demonstrated that cancers of the digestive system (primarily angiosarcoma), respiratory system, brain, and cancers of unknown site, as well as lymphomas, occurred more often than expected in those members of the study population with the greatest estimated exposure. The mortality from other cancers was lower than that of the general male population, with the exception of cancers of the buccal cavity and pharynx. There was an excess of these cancers, which however was inversely related to estimated exposure. The explanation for the latter finding is not apparent.

The other major findings of the study are: (1) The overall mortality of the study population was approximately 75% of what would be expected in a comparable population of U. S. males; (2) No cause of death showed a statistically significant excess over what would be expected in a comparable U. S. male population; and (3) No deaths identified as angiosarcoma of the liver were found other than those previously identified. This is the first epidemiological study which suggests that in humans vinyl chloride may also be associated with cancer of multiple sites.

76.

Ter Haar, G. & Aronow, R. "New information on lead in dirt and dust as related to the childhood lead problem." Environmental Health Perspectives, Vol. #7: pages 83-89 (1974).

This paper reports on a two-part study conducted to evaluate the validity of the dirt-and-dust hypothesis. The first part of the study was made to determine the source of lead in dirt to which children are normally exposed. Dirt samples were taken in old urban areas around 18 painted frame houses and 18 houses of brick construction. Samples were also taken around seven old frame farmhouses remote from traffic. Based on the fact that lead concentrations in the dirt were similar in city and rural yards at corresponding distances from the houses, it is clear that nearly all of the lead in dirt around these houses is due to paint from the houses. Lead antiknock additives are therefore not a significant contributor to the lead content of dirt around houses where children usually play.

The second part of the study used a naturally occurring radioactive tracer (^{210}Pb) to determine the relative amounts of dust and other lead-containing materials (e.g., paint) eaten by young children. This tracer is present in very low concentration in paint and in significantly higher concentrations in fallout dust. Stable lead and ^{210}Pb were analysed in faecal material from eight children suspected of having elevated body burdens of lead and ten children living in good housing where lead poisoning is not a problem. The normal children averaged 4 ug Pb/g dry faeces, with a range of 2 to 7 ug. Of the eight children suspected of having elevated lead body burdens, two had faecal lead values within the normal range. However, the remaining six were 4 to 400 times as high. Despite these differences in faecal lead between the two groups, the groups were essentially identified in the ^{210}Pb content of their faeces. The "elevated" children averaged -.040 pCi of ^{210}Pb dry faeces, while the normal group averaged 0.044 pCi/g. The results provide sound evidence that these children suspected of elevated lead body burden were not ingesting dust or air-suspended particulate.

77.

Tomatis, L. "The carcinogenic risk for man of environmental chemicals." In: Recent Advances in Assessment of the Health Effects of Environmental Pollution, International Symposium. Paris, France: World Health Organization 1974.

The hypothesis that environmental factors play an essential role in the aetiology of human cancer is receiving wide support, and it has been repeatedly asserted that over 80% of human cancers are due to environmental factors. Environmental factors may act directly on individuals exposed and may affect pregnant women and therefore reveal an effect on a subsequent generation. A direct effect of environmental factors in producing cancer in man has been shown by: (1) the unequivocal evidence of the chemical origin of occupational cancer, as in the cases of urinary bladder tumours in workers exposed to aromatic amines, lung cancers in workers exposed to bis (chloromethyl) ether, etc; (2) the well-documented cases of iatrogenic cancers; (3) the positive correlation between cigarette smoking and lung cancer; (4) the different cancer incidences in urban and rural populations and the possible role of air pollution; and (5) the results of studies on migrants showing that for some cancers migrants acquire incidences similar to those of the host countries. Results obtained in experimental carcinogenesis are in keeping with a direct carcinogenic effect of chemicals.

The evidence that exposure of pregnant women to a carcinogen may result in an increased risk of cancer in the progeny has been provided by the reports on the incidences of vaginal cancer in daughters of women exposed to stilboestrol during pregnancy. The role of prenatal exposure in determining cancer risks in the progeny is fully documented in experimental carcinogenesis.

78.

Tyler, David A. (Edit) Resources for Development; Organizations and Publications, Action/Peace Corps. Office of Multilateral and Special Programs, Program and Training Journal Manual Series No. 3A. August, November, 1976.

This document provides an extensive list of organizations disseminating resource materials for development. Agencies are listed from the United States, Africa, Asia, Latin America and other international areas. Information provided includes address, type of organization, type of information or service provided, and a description of the activities in which these agencies are engaged. A separate section lists useful publications with a brief description of foci relevant to developing areas.

79.

Tyroler, H. A. & Cassel, J. "Health consequences of culture change. 2. The effect of urbanization on coronary heart mortality in rural residents." Journal of Chronic Diseases, Vol. #17: pages 167-177 (1964).

The authors show that death rates from coronary heart disease in white males aged 55-64 who were rural residents in North Carolina, has increased with increasing urbanization, and that the differences could not in all likelihood be attributed to changes in diagnostic custom. The gradient was predicted in advance of the study on the basis of postulated incongruities between the culture of rural residents and the demands and expectations of increasing urbanization. Whatever the deleterious influences which accompany urbanization may be, as far as coronary heart disease is concerned the gradient had, in this age, sex, and racial group reached a plateau for urban residents, but it was continuing to rise in the less adapted rural residents.

80.

Wolman, A. "Environmental sanitation in urban and rural areas: Its importance in the control of enteric infections." Bulletin of the Pan American Health Organization 9 (2): pages 157-159 (1975).

In Central and South America, enteric infections constitute one of the leading causes of disease and death. The terrible toll is exacted by a host of different microorganisms, virtually all of which are transmitted via contact with human excreta. To change this picture we need many more water supply systems, better food preparation and handling, and public comprehension of how elementary good hygiene promotes good health. Attaining these objectives will be difficult, but less costly than one might suppose, and there is little to be gained by delay. The basic environmental causes of enteric disease are clear, current conditions have been aggravated by rapid population growth and urbanization, and basic corrective measures have already been postponed long enough. This paper provides a rationale for improvement of environmental health facilities but does not provide specific techniques for control or for program development.

81.

Wolman, Abel "Health priorities in human ecology and environmental pollution." PAHO Bulletin, Vo. #8 (4): pages 351-353 (1974).

The author discusses the environmental health problems facing Central and South America and states that priorities for action must be set. The primary disease problems, according to the author, are the enteric diseases, with diarrhea still a major cause of death. It is concluded that the actual impact on health of a multitude of environmental problems must be weighted to determine in a health context the priorities for attacking these problems. The author proposes that environmental hazards must be evaluated separately with respect to their impacts on human health and that then priorities must be established for control measures.

82.

"The Calcutta water and sewerage project." WHO Chronicle, vol. #25 (1): pages 35-36 (1971).

This article describes the involvement of the World Health Organization in the establishment of Calcutta's water and sewerage project. Costs, sources of funding, development plans, and the involvements of various agencies are discussed. Full details of the project may be obtained by special request from the World Health Organization.

83.

Chinese Medical Delegation to the Scientific Session of the Academy of Medical Sciences of the U.S.S.R. at Tashkent, September 20-25, 1954. "Some aspects of research in the prevention and treatment of Schistosomiasis japonica in New China." Chinese Medical Journal, vol. #73: page 100 (1955).

This paper discusses methods of destroying schistosome ova and methods of killing the intermediate hosts of schistosomiasis -- the snails. Since fecal material is a valuable and natural source of nitrogen as fertilizer, the use of toxic chemicals to kill the ova is not recommended. It was found, however, that the amonia in urine, if combined with feces, will kill the ova after three days of sitting in summer and one week in winter. For killing snails both chemical and physical means are uses; the chemical including copper sulfate, DDT, Paris Green, etc. and the physical including burial in the soil, boiling in water, and burning grass. An integrated program of water and grass control using both physical and chemical means is recommended.

84.

Ciba Foundation Symposium 32, Health and Industrial Growth, Amsterdam: Associated Scientific Publishers, 1975.

This book, which records the papers and the discussions at the symposium held in 1974, begins with the more specific (although large and challenging enough) problems of the directly harmful side-effects of industrial growth. The ways in which control of pollution in the UK is approached are analysed, together with the contribution legislation can make to the protection of health at work. The symposium then widens out to consider the industrial 'growing pains' of developing countries and how they might avoid repeating mistakes made in 19th century Europe. The impact of industrialization on health is taken up from viewpoints varying from Ghana, Iran and India to the South-East Asian region and Japan. The health of the working population in these countries is specifically examined, together with the question of how health needs and problems of the workers can be integrated with those of the whole population, of which the workers are also a part.

85.

Cleaning Our Environment, The Chemical Basis for Action, Washington, D.C. American Chemical Society, 1969.

This text provides an account of the status of the science and technology of environmental improvement and recommends measures to accelerate the use of that science and technology. The topics covered extensively include the air environment, the water environment, solid wastes, and pesticides in the environment. Types of pollutants, their behavior in the environment, their known health effects, and methods for their control are discussed. This text may be useful in providing background in those aspects of environmental health most relevant to the developing world.

86.

Community water supply and wastewater disposal. WHO Chronicle 30: 329 (1976).

The progress made by developing countries in the provision of community water supplies and excreta disposal facilities between 1970 and 1975 is outlined. The mid-decade achievements (1975) in water supply systems are compared with the targets for the Second United Nations Development Decade (1971-80). Suggestions are made for regional targets for the end of the decade and the investments required to meet these targets are estimated.

87.

"Development and environment." United Nations Conference on the Human Environment, Stockholm, 1972.

This paper first presents the major issues of concern with respect to development and the environment. Recommendations are proposed for national, as well as international action. A special report on development and the environment is provided. The basic issues relating to environmental problems in developing countries are discussed and the results of four seminars on development and environment are presented.

88.

"Educational, informational, social and cultural aspects of environmental issues." United Nations Conference on the Human Environment," Stockholm, 1972.

The first chapter deals with the need for action in dealing with environmental problems. The social and cultural dimensions of environmental problems, social and cultural roots of the crisis, and incentives for action are elaborated. The second chapter deals with objectives of action. The third chapter discusses the means of taking action, including knowledge, instruction and education, information, political and institutional action, and institutional implications. Recommendations are presented in the fourth chapter for continuous social diagnosis, educational action, public information and participation, conservation and creation, and exchange of information.

89.

"Environmental aspects of natural resources management." United Nations Conference on the Human Environment, Stockholm, 1972.

This paper provides an approach to integrated resource management with sectoral recommendations for agriculture and soils, forests, wildlife, parks and other protected areas, the conservation of genetic resources, fisheries, water, mining and primary mineral processing, and energy. Both national and international recommendations for action are provided. A summary of recommendations for international action is presented including acquisition of knowledge, international agreements, supporting measures, organizational recommendations, and comprehensive programs.

90.

Environmental Health. WHO Chronicle, vol. #30: pages 22-25 (1976).

This paper provides a summary of the emphases of environmental health needs in Africa and it provides objectives for governmental programs in this area. Also included is a list of those African countries in which environmental health studies have been made and a summary of two major problems; safe water supply and waste disposal.

91.

Environmental Health Planning Guide, U. S. Department HEW, Public Health Service, National Center for Urban and Industrial Health, Cincinnati, Ohio, 1967.

Discusses planning of environmental health programs including preparation and collection and evaluation of the data, and use of the data for implementation. The areas from which data are derived are health agency operations, physical development planning agency operations, air pollution control, food protection, public sewage, public water, radiological health, recreational sanitation, residential environment, sanitation, solid waste collection and disposal and vector control. This guide relates primarily to planning in the United States although portions of it may be useful to the developing nations.

92.

Health Training Resource Material. Program and Training Journal, Action/ Peace Corps.

This training manual includes a chapter on culture resource material providing sensitization for Americans dealing with health problems in developing nations. Topics discussed include values in American culture, the cultural context of health education, problems of introducing public health programs in developing areas, and the rate of beliefs and customs in sanitation programs. The second chapter presents "how to's" for community health education. Discussions include the group approach to introducing new ideas, community organization aimed at encouraging village people to want to use a latrine, a case study of a project to bring latrines to a rural community, a suggested outline for use by countries in discussing health education of the public, and documentation of community data. The third chapter provides sanitation resource materials related to basic health sanitation, safe drinking water, clothes washing, personal hygiene, dishwashing, household pest eradication, waste disposal, food storage and preparation, and infant care. The final chapter discusses school health education with "how-to's." Topics include the contribution of teachers to child health, correlating health with other subject areas, suggestions for a health teaching unit, learning activities, a draft syllabus for health education of ages 6 - 11, and health education of the tropical mother in feeding young children.

93.

Human investiment in environmental sanitation programmes. WHO Chronicle, vol. #30: pages 26-27 (1976).

Specific characteristics of Africans and how their environmental health improvement program might be approached are summarized. It is stressed that many "urban" communities must be dealt with as villages and the people understood within that context. It is suggested that any program should consist largely of the work of the local people and that teamwork should be emphasized. Education is stressed as a necessary component of the entire program at all levels.

94.

Identification and control of pollutants of broad international significance." United Nations Conference on the Human Environment, Stockholm, 1972.

This paper first describes the biosphere as the context within which pollution will be discussed. The nature and extent of pollution problems are presented in terms of how pollutants affect individuals, as well as how pollutants affect communities. The third section details the characteristics of some major

81

pollutants. In the fourth section some major pollution problems are discussed related to the atmosphere, the seas, fresh water, and food. Considerations for national action, such as economics, technology and legislation are presented in section five. Section six discusses international cooperation for pollution control. Section seven details specific areas of needed action including health effects, food control, air and climate, and terrestrial ecology. A comprehensive approach to the problem of marine pollution is proposed. The final section provides recommendations for action.

95.

Managing the Environment, Washington Environmental Research Center, Office of Research and Development, U. S. Environmental Protection Agency, Washington, D.C., November, 1973.

This report on managing the environment grows out of a concern that a significant proportion of today's environmental problems are aggravated by a lack of effective environmental management techniques. The complexity of environmental issues and trade-offs involved in achieving environmental quality necessitate an understanding of the various perspectives on the environment held by government, industry, business, economists, ecologists and the citizenry. The report includes examinations from each of these viewpoints and discusses techniques for citizens participation, management information systems, organizational structures, special regulatory procedures and controls, legal actions and other methods for improving the management of the environment. Contained in this report are papers prepared by 40 different authors covering the full range of environmental management issues.

96.

"Planning and management of human settlements for environmental quality." United Nations Conference on the Human Environment, Stockholm, 1972.

The need for comprehensive environmental development became evident in the course of the preparations for the conference and was stressed by the Preparatory Committee. This concept is, therefore, the main theme of this paper. The sections which follow attempt to explain in more detail why action is urgently needed in the area of human settlements, to identify the ultimate objectives of such action, to underline the need for a comprehensive approach to the problem, to examine the key issues which must receive priority, and to describe objectives. The paper concludes with recommendations for national and international action.

97.

"Research into environmental pollution." WHO Technical Report Series No. 406. Geneva: WHO, 1962.

Basic concepts in the evaluation of environmental hazards are first provided. The areas of research emphasized are air pollution, water pollution, and soil pollution. The magnitude and health significance of these pollutants are described. Specific chemical contaminants are particularly addressed as well as key issues most pertinent to each type of pollution. Recommendations for areas requiring research are presented including general environmental pollution, animal experimentation, standardization of observations, enzyme studies, metabolism of absorbed pollutants, carcinogenesis, mutagenesis, and long-term effects of pollutants on the aging process.

98.

"Rural water supply and excreta disposal," Chapter 7 in Health Sector Assessment for Nicaragua, Submitted by U. S. Agency for International Development, Mission to Nicaragua to Office of International Health, U. S. Department of Health, Education and Welfare, Managua, Nicaragua, February 6, 1976. (pp. 163-183).

This chapter concentrates on two major environmental systems of primary concern in Nicaragua; rural water supply and excreta disposal. Health problems due to a lack of environmental sanitation, especially enteric diseases, are discussed briefly. The current status of water supply and excreta disposal systems in Nicaragua are described. Data is provided on the number of rural and urban homes possessing water supply services and some method of excreta disposal. The environmental health infrastructure is described. Suggestions are provided for future environmental health planning for both urban and rural areas. Five programs are suggested for immediate implementation: rural water to communities of less than 300, strengthened sanitation services, water system maintenance, solid waste studies, and improvement of slaughter house conditions.

99.

"The Sahel epidemiological and environmental assessments project plan." Prepared for Bureau of Africa, Agency for International Development by the American Public Health Association, December, 1976.

In the introductory body of this report the Sahel Epidemiological and environmental assessments project plan is described including its long-range purpose and immediate objectives. The background of the problem is provided with respect to health concerns in the area and the socioeconomic impacts of the endemic diseases. The plan itself is described including methodology, a review of reports and documentation, environmental health problems, and health sector problems. The environmental health assessments emphasize the major endemic diseases in the recipient countries and propose environmental interventions to interrupt the chain of infection. It is reported that sanitary control measures have been almost nonexistent in the past although they are considered one of the most important factors in the control and prevention of these diseases.

100.

A Strategy for a Livable Environment, The Task Force on Environmental Health and Related Problems, June, 1967.

This publication presents the findings and recommendations of the Task Force on Environmental Health and Related Problems established by the U.S. Department of Health, Education and Welfare. The recommendations set forth here total thirty-four, divided into three groups: ten Action Goals, ten recommendations dealing with the Environmental Protection System, and fourteen other recommendations which support the Goals and the System. Included are: a discussion of some basic environmental problems, and suggestions for an integrative approach; goals for air quality, water quality, wasts disposal, population research, urban improvement, materials and chemicals controls, consumer protection, radiation control, occupational health and safety protection, and governmental compliance. Strategies for the attainment of these goals are suggested such as a functional approach to environmental protection. Six common functions are identified as: research and development, determination of criteria and standards, enforcement, manpower development, public awareness and intergovernmental relations. A rationale is included for an Environmental Protection Act.

101.

Syncrisis: The Dynamics of Health, II: Honduras, U.S. Department of Health, Education, and Welfare, Public Health Service, Office of International Health, Division of Planning and Evaluation, May, 1972.

A comprehensive integration of the resources that Honduras has at hand would surely help the country break out of its circular dilemma of disease-poverty-disease. Indeed, the fact that the major diseases from which the population suffers--malaria, intestinal parasitism, malnutrition, and respiratory disease--are preventable and fall under the jurisdiction of already established government programs points to the fact that such programs deserve a higher priority and better administration.

What appears to be a chronic state of ill-health is actually an unreasonable demand made upon an inadequate public health sector. The health sector appears to be inadequate because of inadequacies of other public sectors. For example, the population of Honduras suffers from malnutrition because the high-protein foods raised in Honduras are primarily exported. Enteric infections run rampant because water and sewerage systems are virtually nonexistent, and water supplies are contaminated by human activity. Education of the people of Honduras in health care counts for very little because very few people finish a secondary education. With only 65% of the available hospital beds in use, yet with only one-third of the population never receiving any health care whatsoever, efforts at increased communication and availability should be made. In addition, direct concentration on agrucultural development, adequate water systems, education, and improved disease-eradication procedures are in order. Much of this depends upon administrative reform. These steps are designed to make better use of existing health facilities and to change the relationship between the health sector and other sectors from a negative one to a positive one, thereby reversing the present trend of a population outdistancing its means of support.

102.

Syncrisis: The Dynamics of Health, III: Perspectives and Methodology, U.S. Department of Health, Education and Welfare, Office of International Health, Division of Planning and Evaluation, June, 1972.

This document discusses certain key issues involved in health sector assessments. They include the following: the epidemiologic basis of planning, diagnosis of the health status of a population, assessment of resource adequacy, inter-sectoral problem solving, a conceptual model of assessment of project impact, the costs of disease and the costs of inaction, the role of health planning in health science education, and family planning guidelines for model implementation.

103.

Syncrisis: The Dynamics of Health, VI: Haiti (Revised), U.S. Department of Health, Education and Welfare, Public Health Service, Office of International Health, Division of Program Analysis.

This assessment evaluates the health sector of Haiti. The health status of the population is examined and vital statistics are provided for major disease conditions. The major communicable diseases are discussed. Conditioning factors influencing the health sector such as climate and topography, culture and history, politics, education and communication, economy, and housing and sanitation are evaluated. Nutritional status is considered one of the primary health concerns in Haiti and is addressed in this assessment as such. Agriculture is also evaluated with respect to market, administration, production and technology. The organization of public health services in Haiti, involving financial resources, health infrastructure, health manpower, and training of personnel is assessed. National health and development planning and assistance offered by international organizations are discussed.

104.

Syncrisis: The Dynamics of Health, V: El Salvador, U.S. Department of Health, Education, and Welfare, Office of International Health, Division of Planning and Evaluation, October, 1972.

This document is a sector assessment of the health status of El Salvador. The framework for analysis involves geography, demography and transportation, cultural characteristics, living conditions, nutrition, population growth, major disease problems, and health care received. The conclusions of this analysis describe malnutrition as the primary health problem. Unavailability of health services and lack of adequate sanitation are secondary and tertiary concerns, respectively.

105.

Trace Elements in Human Health and Disease, Volume II, Essential and Toxic Elements Edit - Prasad, Ananda, S., and Oberleas, Donald. New York: Academic Press, 1976.

This collection of monographs provides information on toxic and beneficial effects of trace elements on human health. Included are papers on deficiency and toxicity effects, metabolism, interrelationships between substances, and recommended dietary allowances for the trace elements. The elements included are magnesium, chromium, selenium, manganese, fluoride, cadmium, lead, mercury and others. This series provides an overview of the recent research on health effects of trace elements.

106.

"Treatment and Disposal of Wastes." World Health Organization Technical Report Series No. 367, Geneva: WHO, 1967.

The report is a survey of the status of waste water and solid wastes treatment in the world. Statements on the status of management and disposal methods reflect U.S. conditions rather than worldwide conditions, and are general in nature.

107.

"The U.N. System and the human environment." United Nations Conference on the Human Environment, Stockholm, 1972.

This paper describes the current activities of the United Nations system related to the environment. They are: the planning and management of human settlements for environmental quality; environmental aspects of natural resources management; identification and control of pollutants of broad international significance; educational, informational, social and cultural aspects of environmental issues; development and the environment; and multi-disciplinary aspects of ongoing activities within the United Nations system of organizations. The environmental orientation of the U.N. system, its functions and perspectives, are described. Included are: information collection, interpretation, analysis, and dissemination; monitoring and surveillance; research on causes and effects of environmental changes; development of criteria; development of policy guidelines; establishment of national environmental institutions, legislation and standards, including enforcement; establishment of regional and international agreements; development of technology including its transfer from developed to developing countries; education, training and public information; cooperation on technical aspects; and funding.

108.

World Health Organization Expert Committee on Amoebiasis, Geneva: WHO, 1969.

Cited in WHO, 1972, Health Hazards of the Human Environment.

109.

WHO Expert Committee on the Control of Ascariasis, Geneva; WHQ, 1967.

Cited in WHO, 1972, Health Hazards of the Human Environment.

110.

WHO Expert Committee on Filariasis, Geneva: WHO, 1974.

Cited in WHO, 1972, Health Hazards of the Human Environment.

111.

WHO Expert Committee on Malaria, Geneva: WHO, 1966.

Cited in WHO, 1972, Health Hazards of the Human Environment.

112.

WHO Expert Committee on Trypanosomiasis, Geneva: WHO, 1966.

Cited in WHO, 1972, Health Hazards of the Human Environment.

113.

WHO Expert Committee on Yellow Fever, Geneva: WHO, 1971.

Cited in WHO, 1972, Health Hazards of the Human Environment.

114.

World Health Organization, Regional Office for Europe, "The Health aspects of urban development: report on a Seminar, Stuttgart, 3-7 December 1973." (Doc. No. EURO 4108), Copenhagen: WHO, 1974.

The key theme for the Seminar was the need to consider planning as a process or framework which could serve as a basis for interdisciplinary discussions at local, national, or international levels. It was agreed that the challenge offered by the complexities of urban development in Europe could be met only by effective interdisciplinary planning. Immediate action was required in three areas: (1) more effective methods of pollution control; (2) the strengthening of environmental health staffs; and (3) strengthening the role of the family doctor within the context of the community-based curative and preventive medicine. The Seminar listed some of the major research priorities, and stressed the need for continual development of health criteria and standards, the study of formal planning techniques including the use of systems analysis, the evaluation of programmes, and the broadening of health education. A list of proposals for action by the World Health Organization was prepared.

WATER

115.

Alward, R., Installation of a Solar Distillation Plant on ile de la Gonave, Haiti: Internal Report No. 167, BRACE, 1970.

This report covers the actual installation of the glass and concrete solar still for which plans are given in the above Technical Report No. T58. Illustrates point by point the problems encountered in the actual construction, and the solutions that were found. There are 10 excellent photographs showing the method and stages of construction.

116.

Andreano, R.L. "The recent history of parasitic disease in China: The case of schistosomiasis, some public health aspects." International Journal of Health Services, vol. #6(1): pages 53-68 (1976)

This paper examines the extent to which the prevalence of schistosomiasis may have increased during the period 1958-1964. Certain hypotheses are examined, mainly dealing with irrigation and water conservancy construction. The probable economic and demographic effects of schistosomiasis are also examined. The article concludes that schistosomiasis prevalence probably did increase, but that the economic-demographic effects of this were probably minimal. This is a case study of schistosomiasis control in China. The relationship between the disease and sanitary control are examined.

117.

Astolfi, E. Pren. Med. Argent., Vol. #58: pages 1342-1343 (1971)

Cited in WHO, 1972, Health Hazards of the Human Environment.

118.

Ayad, N. "A short review of the epidemiology of schistosomiasis in Africa." Egypt Journal of Bilharzia, vol. #1 (1): pages 9-27 (1974)

This paper provides a review of the status of schistosomiasis in Africa, describing the interactions of various epidemiological factors. Issues include the relationship of the disease to agriculture, demographic factors, nutrition, and mobility.

119.

Bateman, G., A Bibliography of Low-Cost Water Technologies, annotated bibliography, 1974.

This bibliography was assembled for the following reason: developing countries have the greater proportion of their populations living as farmers in scattered communities, and the technologies for the services we are considering which have evolved for dense populations, prove to be prohibitively expensive for most rural areas. These facts suggest that we should not overlook alternative methods of collecting, treating, and distributing water, or different techniques of waste disposal, that were once used in one form or another throughout most of the world.

This bibliography is a good annotated listing of the literature. Sections include sources of water, access, storage transport and distribution, lifting and pumping, purification and treatment, and standards. The references in this bibliography are mainly concerned with water supplies for domestic and agricultural use--including only a few references to sewage and waste water disposal. Notes on the publications are grouped in a very readable, organized fashion. Unfortunately, perhaps most of the items listed will be difficult to obtain for people in developing countries--many are out of print. Still, this is an excellent bibliography.

120.

Bell, R.G., "The limitation of the ratio of fecal coliforms to total coliphage as a water pollution index." Water Research, Vol. #10(8): page 745 (1976).

Fecal coliform populations of raw sewage, sewage lagoon effluent, and river water were determined by the most probably number technique. The total fecal coliphage populations were determined using Escherichia coli B (ATCC 11303-1) host cells. Then the ratios of fecal coliforms to coliphage were determined and it was found that this is not a reliable index of fecal pollution since the ratios obtained were quite variable. This was attributed to the greater longevity of the phage than the coliform.

121.

Bond, R.G., "Volume III: Water supply and treatment." In: (eds) Straub, C.P. and Prober, R. Handbook of Environmental Control Series, Cleveland, Ohio: CRC Press, 1973.

Tabular data relating to the overall problem of water supply from source to consumable or usable product is presented. Information is provided on water quality characteristics as functions of source, storage, treatment, and distribution. Water supply and treatment is one aspect of the broader area of water resources management and is of primary concern in producing a product acceptable for a variety of uses--potable, municipal, commercial, industrial, agrucultural, and recreational. Information is provided on some of the newer contaminants and approaches being taken regarding their removal. The information provided could be of use to the multi-disciplinary worker within the scope of environmental management, including ecology, earth sciences, resources, recreation, environmental design, and protection. Students in these areas and other professions, such as law, business, political science, and sociology as well as industry, should find it a source of readily available usable information.

122.

Bosch, Herbert M. "U.S. water supply lessons applicable to developing countries." In: (ed) White, Gilbert F., Water, Health and Society, Bloomington: Indiana University Press, 1969.

This paper discusses some of the issues related to water supply in the United States that are most applicable to developing countries. Public health issues are considered with particular discussions of global health problems. Costs of facilities in the U.S. and internationally are briefly addressed. Water treatment is discussed from a historical perspective and the effects of chlorination are noted.

123.

Carlson, S., Haesselbarth, U., and Sohn, F.W., Studies on virus inactivation by chlorine during water disinfection. Zbl Bakt Reihe B 162 (3-4):320 (1976)

The studies described indicate a potential for water borne transmission of viral diseases and the problems involved in virus inactivation by means of water chlorination. The value of the oxidation reduction potential was found to be a criterion of viral inactivation and higher values plus longer periods of contact than for bacteria were found to be necessary.

124.

Cheremisinoff, P.N., Valent, J., Wright, D., Fortier, R. and Magliaro, J. "Potable water treatment: Technical and economic analysis: Chapter 5. Water and Sewage Works, vol. #123 (7): pages 52-54 (1976).

The treatment consists of chemically coagulating the water's suspended particles into a large floc, which is removed either by sedimentation or filtration. The most widely used coagulant is alum or aluminum sulfate, but ferric sulfate or sodium aluminate in conjunction with alum can also be used. The jar test, which simulates the full-scale coagulation-flocculation process performed at a water treatment facility, is used to determine the proper coagulant dosage. Then the coagulants are fed into the water by solution-feed or dry-feed devices and dispersed by a rapid-mixer. A 20-30 minute period of gentle agitation permits flocculation. Either mechanically mixed flocculators, which use slowly revolving paddles, or flocculation tanks with baffles are used. Recently, clarifiers have become popular for water treatment. They are smaller than plants using separate mixing, flocculation, and sedimentation basins in series and are less expensive.

125.

Choudhry, A. W. "Potential effects of irrigation on the spread of bilharziasis in Kenya." East African Medical Journal, Vol. 52 (3): P. 120 (1975).

The potential risk of bilharziasis in Kenya is discussed in terms of what is known of its relationship to irrigation. Two forms of bilharziasis are endemic in Kenya. The development of irrigation schemes has been found to induce intense snail breeding and may lead to serious transmission of infection. Examples of this situation are provided.

126.

Choudhry, A. W., The results of five years of snail control at Ahero Pilot Scheme, Kenya. East African Medical Journal 52 (10) : 573-7 (1975).

An integrated snail control program to prevent an anticipated increase in bilharzia transmission was initiated at the inception of the Ahero Pilot Scheme in 1969. The results during the last five years of routine application of N-tritylmorpholine indicate that the irrigation system has remained free of intermediate snail hosts. This paper discusses the procedures, costs and effects of this snail eradication program in the newly-developed water system.

127.

Cross Jr., F. L. (ed) "208 planning: What's it all about?" Environmental Monograph Series, vol. #8, page 78, Westport, Conn.: Technomic Publishing Company, 19 6.

The impact of Section 208 of the Federal Water Pollution Control Act is examined. Topics considered include the local and regional planning required to reach water quality standards by 1983, measuring and monitoring systems, wastewater treatment and management techniques, legal implications of the Act, public and state participation in implementation of the Act, and trends in governmental control of water pollution.

128.

Crowley, C. R., Popular Mechanics Hydraulic Ram, Reprint #X346, New York: Popular Mechanics.

This reprint from Popular Mechanics, a magazine, has two parts. The first explains the operation of a hydraulic ram, simplified methods enabling anyone to determine how much water can be lifted from a stream to the place where it will be used, how to measure the amount of water flow in the stream, and where and how to install the pump. The second part describes a design for an actual ram pump made from standard plumbing parts. The drawings and construction are clear, and the design is quite good. The materials and production processes required may not be locally available everywhere, however, it would be possible to convert this design to a village resource base.

129.

Dietrich, Bernd H. and Henderson, John M. Urban Water Supply Conditions and Needs in Seventy-Five Developing Countries. Geneva: WHO, 1963.

A summary of the existing urban water supply conditions, deficiencies, and needs of the seventy-five developing countries is provided. The role of urban water supply in public health and economic development is discussed. Immediate and ultimate goals are presented with a discussion of present and future needs, costs and means of financing. Sources of data and findings on the current status of urban water supply are evaluated.

130.

Epstein, S. S. "Potential carcinogenic hazards due to contaminated drinking water." In: (eds) Tourbier, J. and Pierson Jr., R. W. Biological Control of Water Pollution, pages 73-84, Philadelphia, Pennsylvania: University of Pennsylvania Press, 1976.

The recent recognition that the majority of human cancer is caused by chemical agents coupled with the statistic that about 20% of the American population dies of cancer confers on this subject the utmost gravity. The case for environmental causation of cancer is strengthened by studies relating urban lung cancer to air pollution. Asiatic oral cancer with betel nut chewing, Bantu liver cancer and fungal aflatoxins, and Japanese and Icelandic gastric cancer with the nitrosamines in a high-fish diet. This subject is elaborated with respect to the categorization and identification of chemical carcinogens, toxicological aspects, the predictive value of carcinogenicity testing, and epidemiological considerations. Chemical carcinogens in U. S. river and drinking water are tabulated. The rationale for the 1958 Delaney Amendment imposing a zero tolerance for carcinogenic food additives is that there exists no way for determining a safe intake level for a known carcinogen. Epidemiological studies on carcinogens in New Orleans drinking water are discussed.

131.

Fannon, R. D., "Field research and testing of a water hand pump for use in developing countries." Final Research Report to A.I.D., 43 p., 1975.

The basic requirements for a dependable and durable hand pump for use in developing countries are listed as: (1) low production cost, (2) long life under severe conditions, (3) easy to maintain with simple tools and unskilled labor. Two pump types, shallow well and deep well, were designed. Both were assembled from a few basic, interchangeable parts. General design provided for ease of pumping and effort was made to keep the handle force below 40 pounds to permit use by children. Three test areas were designated: Thailand, Nigeria, and Bangladesh. Complete sets with samples assembled were sent to each country. Design adjustments were made during follow-up in each country.

132.

Faust, M. A., Coliform bacteria from diffuse sources as a factor in estuarine pollution. Water Research, Vol. #10 (7): page 619 (1976).

The contribution of 849 ha of rural watershed to the fecal coliform pollution of the Rhode River, a subestuary of Chesapeake Bay with a surface area of 485 ha, was estimated. Three factors having a role in fecal coliform pollution of an estuarine ecosystem were emphasized as: (1) the rural watershed contribution; (2) the season of the year; (3) the persistence of bacteria in the estuary along with water temperatures.

133.

Gehm, H. W. and Bregman, J. I. (eds) Handbook of Water Resource and Pollution Control, page 840, New York: Van Nostrand Reinhold Company, 1976.

Advanced techniques of preparing and distributing potable water are described, with methods of overcoming the limitations of water treatment plants. The engineering aspects necessary for meeting all consumption demands are outlined. Data are provided on nearly 200 U. S. public water supplies. All major innovations of wastewater treatment are covered, including the treatment of municipal and industrial wastes. Computational techniques for the determination of equitable cost allocation of treatment are presented, and the disposal of treatment sludges is considered. Other topics are a section-by-section analysis of the Federal Water Pollution Control Act, the desalination of ocean water, uses for thermal discharges, new developments in cooling systems, and the management of underground water resources.

134.

Gibson, U. and Singer, R., Water Wells Manual, Berkeley, Calif.: Premier Press, 1969.

This is a "simplified, small wells how-to" manual. A good knowledge of English is necessary. It is intended as a "basic introductory textbook" and to "provide instruction and guidance to field personnel engaged in the construction, maintenance and operation of small diameter, relatively shallow wells used primarily for individual and small community water supplies." ("Small" used here means up to 4" in diameter.) Topics include background information on water cycles, geologic formations, water quality, groundwater exploration, well design, well construction and maintenance, sanitation and wells, and a review of various types of pumping equipment and energy sources including a discussion of the advantages and disadvantages of each. This book would be useful for a community development worker who reads English well but has no formal training in water supply and/or well design. It is, however, oriented toward more technically minded people, even though it is described as "simplified." Nevertheless, it is useful as a background reference.

135.

Goldbert, E. D. "Toward a global monitoring program for transuranics and other marine pollutants." In: (eds) Miller, M. W. and Stannard, J. N. Environmental Toxicity of Aquatic Radionuclides: Models and Mechanisms. Ann ARbor, Michigan: Ann Arbor Science Publishers, 1976.

Four collectives of pollutants that threaten the marine environment have been identified as petroleum, artificial radioactive nuclides, heavy metals, and halogenated organic compounds. A global monitoring program based on the use of 2 sentinel organisms, mussels and barnacles, is proposed and described. The initial annual costs of collection and analyses should be $300,000 for 100 samples taken from open-ocean waters.

136.

Gruener, N., and Shuval, H. I. "Evaluation of the health effects of nitrates in water." In: Recent Advances in Assessment of the Health Effects of Environmental Pollution, International Symposium. Paris, France: World Health Organization, 1974.

The standard for nitrates in drinking water was established as 45 mg/l based on limited epidemiological and experimental evidence. We initiated a broad range of toxicological and epidemiological studies to provide a scientific basis for evaluating the health effects of nitrates in drinking water. The two epidemiological studies to be reported upon here are part of this project. One of the studies which was done among 408 healthy infants who consume appreciable amounts of tap water in powdered milk formula showed that those infants who consume water with nitrate concentrations over 45 mg/l exhibited significantly raised methemoglobin levels in their blood. The second epidemiological study was done under controlled conditions in a hospital to attempt to determine the threshold value of nitrates in water which can cause a significant increase above "normal" methemoglobin levels in infants. In this study with 115 infants we showed that nitrate levels in drinking water of about 100 mg/l can cause a significant increase in infants' methemoglobin levels. The possible health significance of a slightly raised or subclinical methemoglobin level as found in the two studies is discussed in light of results from toxicological studies and general considerations in evaluating the risk of population exposure to chemicals in the environment.

137.

Harris, R. H. "Carcinogenic organic chemicals in drinking water." In: (eds) Tourbier, J. and Pierson Jr., R. W. Biological Control of Water Pollution, pages 63-72, Philadelphia, Pennsylvania: University of Pennsylvania Press, 1976.

The question of carcinogenicity is reviewed for petroleum and coaltar chemicals and products, aromatic amino and nitro compounds, and pesticides and soil sterilants. Epidemiological studies on cancer are related to the identification of chemicals in potable waters. Known and potentially hazardous chemicals in the water supply are tabulated for selected American cities. With the growing recognition of the environmental causation of cancer, regulatory attention must be directed towards chemical carcinogens in drinking waters. Statistical studies suggest that cancer mortality rates are related to water quality in those communities deriving drinking water from polluted sources. Dwindling research funds have resulted in the virtual halt of advances in the technology of organic contaminant identification and removal. The continuation of this trend must result in the increased risk of cancer from polluted drinking water.

138.

Hattingh, W. H. J. and Nupen, E. M. "Health aspects of potable water supplies." Water S. A., vol. #2 (1): pages 33-46 (1976).

A 10-year research program to assess the chemical and microbiological quality of potable water, including water reclaimed from purified sewage effluents, is presented. Eight different but related aspects of water quality were studied. Results obtained during the first 2 years of the investigation show that the quality of all potable waters tested to date was excellent, and that of reclaimed water was the same, if not better, than potable water from surface sources. Those aspects needing further research are also indicated and center around a knowledge of the pollutants present in the water environment. Pure chemical and microbiological assays will have to be supported by bio-assaying techniques to assess the long term effect of pollutants present in small concentrations.

139.

Hodge, H. C. and Smith, F. A. "Minerals: fluorine and dental caries." Advan Chem Ser, vol. #94: pages 93-115 (1970).

Source not referenced.

140.

Huff, E. S. "Careful chlorination yields multiple savings." Water and Sewage Works, vol. #123 (7): pages 42-43 (1976).

Increased emphasis on environmental protection has increased the practice of chlorinating effluents from waste-water treatment plants. However, the toxic effects of Cl on certain aquatic organisms and the energy impact of its production should limit its use as a disinfectant by plant operators. Data from a small trickling filter plant which discharges to a stream with a seasonally variable flow are presented and indicate that reducing Cl residuals to 1 mg/l would lower the in-stream concentrations during the summer months to the lower end of the toxic concentrations. Also, 15%-20% of the electricity used by the plant could have been saved by not producing extra Cl in the summer.

141.

Huisman, L. and Wood, W., Slow Sand Filtration, Geneva: WHO, 1974.

The slow sand filter is one of the best means of treating a raw water supply where specialized chemical technology is not available. Far from being an old-fashioned technology, the authors feel that the slow sand method can be the cheapest, simplest and most efficient method of water treatment. Several scales of design are discussed and illustrated, although knowledge of basic engineering mathematics would be helpful. The last part of the book discusses the use of sand filters for recharging ground water, an important consideration for arid areas. In areas of known biological contamination, however, the use of chemical treatment (chlorine or preferably iodine) along with sand filtration would provide a very safe water supply. Slow sand filtration methods are also very simple to operate: "Provided that a plant has been well designed and constructed there is little that can go wrong as long as the simple routine of operation is carried out." A very valuable book for those involved with planning water supplies for small to medium size communities.

142.

I-Cheng Ch'i and Blackwell, R. Q., American Journal of Epidemiology, Vo. #88: pages 7-24 (1968).

Source not referenced.

143.

Jahn, S. A. A. "Sudanese native methods for the purification of Nile water during the flood season." In: (eds) Tourbier, J. and Pierson Jr., R. W. Biological Control of Water Pollution, pages 95-106, Philadelphia, Pennsylvania: University of Pennsylvania Press, 1976.

The Nile during its flood period contains very high (≥7,000 mg/10 concentrations of suspended solids which may require ≤ 20d to settle completely. Since the Nile supplies some or all of the water for many localities, clarification methods that can be carried out under primitive conditions assume great importance. A type of clay soil found in certain sites along the river is used by the natives as a flocculant. This was characterized as consisting mainly of

Bentonite. Various indigenous plant materials, usually pulverized seed matter, are also used as clarifying agents. The identity, distribution, effectiveness, and mode of action of these substances are surveyed.

144.

Kindel, Ersal, A Hydraulic Ram for Village Use, Volunteers in Technical Assistance, 1975.

This manual consists of working instructions and drawings on how to construct a small, simple hydraulic ram from commercially available water pipe fittings. The ram described has a supply head of 6.5 meters, a delivery head of 14 meters, with a delivery of 7 liters/minute. It is thus only used for small water supplies. Although less detailed and thorough than the Popular Mechanics article, this information is more adapted to village resources. The operating principle is simpler than the Popular Mechanics designs, but both should work equally well. If possible, it would be helpful to look at more than one of the designs listed here (ITDG, Popular Mechanics and VITA) before building a ram.

145.

Kneese, A.K. and Bower, B.T. Managing Water Quality: Economics, Technology, Institutions, Baltimore, Md.: Johns Hopkins, 1968.

Source not referenced.

146.

Lambo, T.A. "The protection and improvement of the world's drinking water quality." In: (eds) Tourbier, J. and Pierson Jr., R.W. Biological Control of Water Pollution, pages 23-29, Philadelphia, Pennsylvania: University of Pennsylvania Press, 1976.

The biological hazards of poor quality drinking water are dramatized by recent outbreaks of typhoid fever. A wide range of chemical hazards includes nitrates, As, Pb, Cd, Hg and Hg compounds, DDT, aldrin, and a host of industrial contaminants. The most spectacular manifestations of the latter were the Cd and methyl mercury poisoning episodes in Japan. The total demand for water is estimated to double every 20 years, and in some countries every 10 years. A scientific approach to water quality control is needed that will exclude both unnecessary scares and a false sense of security, and which has the maximum cost-benefit ratio. Some industrial wastes are so difficult or so expensive to remove that the only feasible solution may be legislative restriction. The increasing costs of energy will necessitate increased reliance on biological treatment processes. The role of WHO in water quality management is reviewed.

147.

Lawand, T.A., Simple Solar Still for the Production of Distilled Water, Technical Report 117, TRACE, 1965 (revised 1967).

This unit was "designed primarily for use in service stations with the object of providing distilled water for automobile batteries." Distilled water is very necessary for battery maintenance, especially in arid regions. This still will produce an average of 3 liters per day. Clean fresh water (can be collected on roof during rainy season) is added to the still each day--distilled water is drained off. Users must be careful with the storage of the distilled water to avoid contamination.

148.

Lawand, T.A. and Alward, R., Plans for a Glass and Concrete Solar Still: Technical Report No. T58, BRACE, 1972.

This report contains a series of plans and specifications for a solar distillation plant designed by the Brace Research Institute for a site in Haiti. The average output is 200 gallons of distilled water per day. The units are simply built and, apart from plumbing, are composed of four components, concrete curbs, a butyl rubber basin liner, glass panes for the transparent cover and a silicone glass sealant. This system is actually a series of solar stills connected together.

149.

Levine, R.J., Khan, M.R., D'Souza, S., and Nalin, D.R. "Failure of sanitary wells to protect against cholera and other diarrheas in Bangladesh." Lancet 2 (7976): 86-89 (1976).

Within an area of Bangladesh in which the incidence of cholera was high, use of sanitary pipe wells did not protect against cholera or related non-cholera diarrheas because well users also used contaminated water sources regularly enough to maintain high infection rates. Protection was found to correlate with education and wealth. This paper points out that technology without education may not be effective in the control of enteric waterborne diseases.

150.

Logan, J.A., The quantitative relationships between community water supplies and economic development. International Review of Tropical Medicine, 2:27-40 (1968).

The author stresses the different economic aspects of water supply and the contribution of water to general socio-economic development--agricultural development, the establishment of industries using water or producing hydraulic equipment, and health improvement. It is difficult to assess the role of water supply in development from the health angle, since knowledge of the part played by water in the improvement of health is unsatisfactory. The author mentions, however, calculations already made concerning the economic effectiveness of water supply (number of deaths and diseases avoided, savings made by health services).

151.

Lyon, W.A. "Comments on the history and economics of micropollutants in drinking water." In: (eds) Tourbier, J. and Pierson Jr., R.W. Biological Control of Water Pollution, pages 91-93, Philadelphia, Pennsylvania: University of Pennsylvania Press, 1976.

There have been many expressions of concern over micropollutants in the past 25 years, but only during the past year has serious public attention been directed to the issue. The Federal Drinking Water Act provides $7.5 million for fiscal year 1975 for the states in dealing with this problem. An estimated $36.8 million is needed for dealing with all the items of the act. During a recent odor and taste episode, the West Penn Water Company of Pittsburgh, Pennsylvania, agreed to provide activated carbon treatment of the water. The approximate cost would be $2.50/yr/customer for this system serving 1½ million customers. The cost of this extra treatment step for systems with 40,000, 1,300, and 500 customers would be $12, $90, and $300/yr/customer, respectively. When it is considered that nearly ½ of Pennsylvania's 1,300 public water supplies serve 800 customers, the great importance of scale factors for water treatment becomes apparent. The relationship between cardiovascular disease mortality and drinking water hardness is another item of grave implication.

152.

Majumder, N. "Piped water supply for rural communities; an experiment in a South Pacific island." Indian Journal of Public Health, Vol. 11(3):133-137, (1967).

Protected water supply for rural communities have presented a difficult problem to health workers all over the world. Need of adequate quantity of protected water to each individual in a community does not require any justification. Location of a suitable source, collection, conditioning and distribution of the water to the people are the usual problems to be solved by the water engineer. Advantages and disadvantages of a piped water supply are discussed. A case study of a piped water supply on the island of Tongatapu, Kingdom of Tonga, is presented. The author states that the single most important factor, besides the technical aspects, influencing the success of a rural sanitation project is cultural acceptance.

153.

Masironi, R., Koirtyohann, S.R., and Pierce, J.O., Calcium content of river water, trace element concentrations in toenails, and blood pressure in village populations in New Guinea. Science of the Total Environment, Vol. #6 (1): page 41 (1976).

Several studies of industrialized population groups have revealed an inverse relationship between hardness of drinking water and certain cardiovascular disease parameters, e.g., death rates, blood pressure, blood cholesterol, etc. This paper was designed to test this inverse relationship in a "primitive" non-industrialized population and it was found that the relationship did still hold.

154.

McClure, F.J. Water Fluoridation, U.S. Department of Health, Education and Welfare, National Institute of Health, 1970.

Cited in WHO, 1972, Health Hazards of the Human Environment.

155.

McHarg, I.L. "Biological alternatives to water pollution." In: (eds) Tourbier, J. and Pierson Jr., R.W. Biological Control of Water Pollution, pages 7-12, Philadelphia, Pa.: University of Pennsylvania Press, 1976.

Our modern prevailing philosophy of water management seems to assume an inalienable right, either as individuals or as members of a municipality, to befoul our neighbor's water supply. Similarly, industry in the name of modern technology unashamedly dumps all manner of wastes into the nearest available receiving water without regard for anybody. The national government also in its nuclear and other programs commits the grossest insults to the nation's health and well being. The sanitation engineer in treating the resulting mess ignores the role of microorganisms in water treatment and gases them all to death with Cl. We must recognize that clean, potable water is a by-product of biological systems. A 1st priority is the establishment of an administrative structure for the planning, management, and regulation of water resources. We must recognize that wastes for us are nutrients for microorganisms, and learn to depend ultimately upon these creatures for our water purification. The future of water treatment must be ecologically and limnologically oriented.

156.

Morris, J.C. "Environmental physics and chemistry of aquatic pollutants." Nonbiological Transport and Transformation of Pollutants on Land and Water: Processes and Critical Data Required for Predictive Description, page 6, 1976.

A water pollutant's volatility, aqueous solubility, and absorptive tendency determine the likelihood that it will translocate into the air or the sediments. The chemical transformation by which this happens are either hydrolytic or oxidative, are affected by temperature and pH, and include direct oxidation with O_2, catalyzed oxidation, photooxidation, or photosensitized oxidation. A pollutant's susceptibility to these processes are important in determining its ultimate fate, and field observations that can be correlated with laboratory data are needed to demonstrate the relative importance of the individual physical and chemical properties involved.

157.

Muhammed, S.I., and Morrison, S.M., Water quality in Kiambu District, Kenya. East African Medical Journal 52 (5): 269 (1975)

This paper describes examinations of 3 springs, 4 boreholes, 24 open dug wells and 7 rivers in Kiambu District, Kenya assessing potability. Comparisons are made of total coliforms, faecal coliforms and Clostridium perfringens as indices of pollution. It was determined that the faecal coliform test using the membrane filter technique was the best indication of contamination.

158.

Perry Jr., H. Mitchell, and Perry, Elizabeth F. "Possible relationships between the physical environment and human hypertension: cadmium and hard water." Preventive Medicine, Vol. 3(3):344-352 (1974).

There is no proven relationship between the physical environment and the pathogenesis of essential hypertension. There are, however, marked and unexplained variations in death rates from cardiovascular disease in the United States. Potable watern an environmental influence to which all persons are exposed, also varies considerably in its hardness and this hardness is inversely correlated with cardiovascular death rates. Experimentally, chronic feeding of cadmium, and perhaps mercury to rates in trace quantities can cause a mild to marked elevation of blood pressure which has been associated with increased mortality. This metal-induced hypertension in animals resembles essential hypertension in man in that there are no other evidences of metal exposure, and it raises the possibility that some clinical hypertension might be related to inapparent metal exposure which in turn might be a function of water hardness.

159.

Pineo, C.S. and Subrahmanyam, D.V., Community Water Supply and Excreta Disposal Situation in the Developing Countries, Geneva: WHO, 1975.

This paper revaluates past water supply and excreta disposal programs and describes the 1970 WHO Global Survey. The content of the community water supply survey is elaborated. The following are included: populations supplied with water; water quality control; planning, construction and extension of water supply; maintenance and operation; reporting; external assistance; unit data on consumption, cost, etc.; long-term program goals; training; research and development; and constraints to progress. Methods of data collection are described. The results of the survey reflect coverage of sanitary services internationally, health aspects, relationship to economic status, manpower needs, criteria for providing community water supplies, constraints to progress and the interdependence of constraints. Factors contributing to successful programs such as community participation, simple technology and standardization, government support and economics and financing are discussed. Targets and prospects for the future are proposed.

160.

Reid, George K. and Wood, Richard D. Ecology of Inland Waters and Estuaries. New York: D. Van Nostrand Company, 1976.

This book discusses the major principles of aquatic ecology. The four sections describe, respectively: the history of aquatic ecology and the nature of water; the development and major parameters of basins and channels; the physicochemical variables of natural waters; and the biotic principles (and the plant and animal communities) that make up the living substance of real ecosystems. Key ecological concepts, such as trophic structure, biogeochemical cycles, limiting factors, succession, productivity, and energetics are presented within the above sections. This text is most useful in introducing concepts of aquatic ecology to the student. It does provide an understanding of the aquatic system and the interrelationships within it.

161.

Rosenfield, Patricia L., Emrey, Robert C. and Anderson, Martha, Rural Water Supply and Sanitation in Developing Countries. Washington: Office of Health, A.I.D., 1976.

The concensus of international specialists is that deficiencies in the water-to-waste cycle must now be attacked forcefully in lesser developed countries because of the close relationship between sanitation and many health, nutrition, and other social problems. Among the numerous environmental problems bearing on human health we have chosen to concentrate here on rural water supply and excreta disposal systems. Existing sanitation technologies and construction techniques are considered adequate to provide reliable water to people in most parts of the developing world. The need now is for a concerted effort by national and international agencies to improve these crucial rural services. This publication is useful only as a description of the sanitation problem existing in most rural communities of the developing world.

162.

Spangler, C., Hand Pumps for Village Wells, Volunteers in Technical Assistance, 1975.

This publication reviews the principles of operation of piston and diaphragm hand pumps used in many parts of the world. Deep and shallow well types are included. There are clear drawings of the various types that show the general features and method of operation. Although detailed designs are not given, the design principles are simple and clear. Materials such as metal castings and PVC pipe are recommended, but simpler, locally available materials such as wood could be used. Adaptation to fit local conditions will be necessary.

163.

Taylor, N. "Medical aspects of nitrate in drinking water." Water Treatment Exam 24 (3):194-205 (1975).

The hazards of excessive quantities of nitrate in drinking water are discussed with regard to the incidence of well water cyanosis occurring among bottle fed infants under 3 months of age from areas where well water high in nitrate is used to make up the babies' feeds. Information is presented on the diagnosis of this illness, its rate of incidence, and preventive measures through retrospective epidemiology, hypothetical toxicology and prospective epidemiology. The incidence of well water cyanosis in the UK is discussed, and details are given on the U.S. Public Health Service Drinking Water Standards and the WHO International Drinking Water Standards recommendations that the nitrate level of water consumed by infants should not exceed 45 mg/1.

164.

Toth, K., Optimum and tolerated intake of flourine. Acta Medica Academiae Scientiarum Hungaricae, Vol. #32 (1-2): page 1 (1975).

Optimum and tolerated intake of flourine has been studied on the basis of body weight, caloric and fluid requirements of subjects belonging to different age groups. The main F source is drinking water which normally contains 1 mg F/liter. The optimum per Kg of body weight is 0.045 mg in infants and decreases with age. The tolerated and chronic tolerated levels have been estimated for different age groups.

165.

Tourbier, J. and Pierson Jr., R.W. (eds) Biological Control of Water Pollution. Philadelphia, Pa.: University of Pennsylvania Press, page 340, 1976.

Thirty-nine papers are presented covering the rationale for biological treatment, limnology, potable water quality, biological methods for wastewater, aquifer recharge, and waste treatment alternatives. Specific topics include water quality legislation, carcinogens in water supplies, macrophytes and water purification, aquatic ecosystems, and the land application of wastewater. Other subjects are aquiculture and wastewater treatment, oxidation ditches, numerical models for groundwater management, EPA policies and wastewater alternatives, and water pollution control in the developing countries.

166.

Trieff, N.M., Hinton, R., Stanton, G.J., Songer, J.G., and Grajcer, D. "Sewage treatment by controlled eutrophication using algae and Artemia. In: (eds) Tourbier, J. and Pierson Jr., R.W. Biological Control of Water Pollution, pages 231-239, Philadelphia, Pennsylvania: University of Pennsylvania Press, 1976.

In this approach algae fix the organic and mineral components of the sewage by a photosynthetic process, and the shrimp graze on the algae, keeping them at an optimum level of long-phase growth that does not exceed the nutrient level present in the sewage. The combination of algae and shrimp reduced the suspended solids from 120.0 to 20.0 mg/l, the BOD_5 from 318 to 23 mg/l, and phosphate (PO_4^{-3}) from 20.0 to 10 mg/l. A 2nd treatment of the processed effluent with algae further reduced the suspended solids, BOD_5 and PO_4^{-3} to 3.5, 4.5 and 4.8 mg/l, respectively. An inactivation of pplio virus is observed for both the salt water and the algae; a total inactivation of 99.95% is extrapolated for all components of the system. Further study of the brine shrimp will be required with respect to virus transmission, parasites, metals, and toxic organics before their use as food can be considered safe.

167.

Turneaure, F.E., and Russell, H.L. Public Water Supplies, New York: Wiley, 1950 .

Source not referenced.

168.

Underwood, E.J. Trace Elements in Human and Animal Nutrition, New York: Academic Press, 1971.

Source not referenced.

169.

Valentine, J. Personal communication regarding present status of arsenic controversy. (1977).

This communication provides that current researchers on the health effects of arsenic exposure are in controversy. Previous assumptions as to the mechanisms of arsenic toxicity are being questioned. The relationship of arsenic and cancer is being reevaluated.

170.

Wagner, Edmund G. and Lanoix, J.N. Water Supply for Rural Areas and Small Communities, Geneva: WHO, 1959.

The development of a water supply program is discussed in terms of health significance, objectives, the role of the central government and health administration, community participation, and the role of the sanitary engineer. The basic considerations in planning such as personnel and training, finance, water supply policy, design, and water quality are presented. The installation of various types of water supply systems are described in some detail for ground water, pumps, surface water, treatment under rural conditions, and distribution and use. Management of water supply systems is addressed, stressing personnel and training, administration and finance, operation and maintenance, and long-term planning. This text may be useful for rural communities of developing countries, especially the installation methods.

171.

Watt, S., Chinese Chain and Washer Pumps, Intermediate Technology Development Group, 1976.

This publication contains 21 versions of the chain and washer water lifting device, displayed at the 1958 Peking Agricultural Exhibition, in China. Each version of the pump was designed and built by separate communes, using local materials, skills and tools. A description of each pump with performance figures was written up in the simple information sheets that have been literally translated for this publication. The drawings presented are on the information sheets, and have been copied to allow anyone with a basic understanding of mechanics to build one of the devices, construction details are not included in this publication. Each pump design listed has information on the rate of pumping and a summary of the construction method and materials. The introduction described the principles of operation of chain and washer pumps, components of the pumps, design factors, and power sources available for water pumping (human, animal, wind, solar, and electric). The appendix includes 5 more pump designs, from India, France and Britain.

172.

Watt, S.B., A Manual on the Hydraulic Ram Pump, Intermediate Technology Department Group, 1974.

We have written this manual primarily to show field workers how they can design and construct a simple ram pump from commercial pipe fittings, how to choose a suitable site for the ram, how to install and adjust the ram, and the sort of maintenance the pump will need during its working life. We have tried to write the manual in non-technical language so that it can be used by people with little or no technical training; this information makes up Part K. In Part II, we describe in greater detail the range of operation of ram pumps, and the different materials that have been used to make them. This part of the manual will be of interest to those who have a basic understanding of engineering materials and simple mathematics, as it explains the calculations necessary to design a ram.

If placed where this ram can be used, it has many advantages over other pumps powered by hand, animal, wind or motors, despite the fact that a lot of water passes through it without being pumped: (a) it does not need an additional power source and there are no running costs; (b) it has only two moving parts, and these are very simple and cheap to maintain; (c) it works efficiently over a wide range of flows, provided it is tuned correctly; (d) it can be made using simple workshop equipment.

173.

Bamboo Piping: An Experiment in Mezan-Teferi, Ethiopia (A.T. Unit Report #5), Appropriate Technology Unit, Christian Relief and Development Association, Addis Ababa, Ethiopia.

This is a very good overview of the necessary conditions for the use of bamboo piping. Much of the information has been reprinted from the VITA Village Technology Handbook section on bamboo water pipes; but the additional material here and the case study information make this a valuable addition to that section.

The authors did not have much success with a circular punch tool for knocking out the innter dividing walls of the bamboo. They developed a simple drilling bit which can be easily made by a blacksmith (drawings and photos of this bit are provided). With this tool 3 workers could easily bore out twelve 7-meter bamboo poles in one hour. The experimenters also developed a unique joint sealing system in which soaked cowhide is wrapped around the joint twice and sealed tight with two pieces of galvanized wire. The authors note that bamboo piping can be expected to serve for 3-4 years, and that the pipes can carry water for irrigation as well as for domestic human use.

174.

How to Make a Solar Still (plastic covered), Brace Research Institute, 1965 (revised: 1973).

This leaflet permits the user to make a relatively inexpensive solar still primarily out of plastic sheets and bricks. It is not what might be recommended for a long-term installation. However, this plastic covered unit can certainly be adequately used for temporary installation. It has the advantage of being suitable for units producing anywhere from 1 gallon to 1,000 gallons per day, and will operate for long periods in isolated locations without attention. No auxiliary power source is needed, other than means for feeding water into the unit. 12 square feet of solar still area are needed to produce one gallon of water daily. A 400 square-foot still in the West Indies cost US $228.00 for materials. To really use this leaflet well, one would have to improvise considerably. The size they chose is 100 feet long, with a concrete base--hardly a temporary enterprise--yet the plastic sheeting will last only 6 months to 2 years even though it represents 1/2 the cost of the materials. The task of replacing it is easy. These instructions are thorough.

175.

International Standards for Drinking Water, Geneva: WHO, 1971. (3rd edition)

This most recent edition of the World Health Organization drinking water standards discusses surveillance, the examination of water, and sampling. The types of examination include bacteriological, virological, biological, radiological, and physical and chemical. Standards for bacterial and chemical quality are provided. Sampling techniques for the above types of examination are described with respect to frequency and collection, transport and storage of samples. The techniques and recommended levels presented in this publication may be used as guidelines for establishing water quality.

176.

International Standing Committee on Water Quality and Treatment. "Nitrates in water supplies." Aqua Quarterly Bulletin of the International Water Supply Association, Vol. #1, pages 5-25 (1974).

The Committee presents a comprehensive review of nitrates in water supplies, their relationship to methaemoglobinaemia, and, as a result of the formation of nitrosamines, their possible association with cancer. The importance of the problem in various parts of the world is estimated and recommended limits for nitrates in potable water supplies are discussed. There is a bibliography of 67 references.

177.

The Jensen Hand Pump, (A.T. Unit Report #6), Appropriate Technology Unit, Christian Relief and Development Association, Addis Ababa, Ethiopia.

This report introduces a remarkable, easily built hand pump being tested at the National University of Ethiopia. It consists of a length of pipe with a foot valve, but no inner moving piston. The upper end of the pipe hangs on a spring, and has a handle attached. As the pipe is pushed up and down the water comes out the top. The pump is self-priming and high lifts are theoretically possible. Construction is simple, requiring only basic plumbing and sheet metal work. "A simple foot valve appearing to give satisfactory service is a rubber disc (minimum of 2mm thick) seated against a steel plate in which 5-10 mm diameter holes have been drilled." This foot valve is easily locally made. In a test, a 4-inch diameter pipe pump operated by one man at a lift of 6.4 meters and 75 strokes a minute had an output of 245 liters/minute. Under roughly the same conditions, a 2-inch diameter pipe pump with a commercial foot valve could only lift 45 liters/minute (demonstrating that the home-built valve is better adapted to the design). A good description of the pump, but no drawings are included.

178.

Manual of Information--Rife Hydraulic Rams, Milburn, N.J., Rife Hydraulic Engine Manufacturing Co., 1975.

This pamphlet covers the information you need to install a ram; where to place it, how to estimate the water output, how to measure the flow, choosing the size for the drive and delivery pipes. Describes the operation of a ram, but does not describe a ram design. The information is aimed directly for use with rams manufactured by Rife, not any ram, so this booklet's usefulness is limited. It does, however, provide an introduction to the subject of hydraulic rams.

179.

Shinyanga Lift Pump, Geneva: World Council of Churches, 1973.

This is an easy to construct hand pump, used in villages in Tanzania. Made of 2-inch water pipe, with minor plumbing fittings. A length of 1/2-inch rod with a steel ring is the piston. A 1 1/8-inch steel ball and plastic ring make up the foot valve.

180.

Solar Distillation as a Means of Meeting Small Scale Water Demands, New York, N.Y.: United Nations, 1970.

An excellent manual on all sizes of solar distillation plants for providing fresh water in small communities. The purposes of the manual are "to review the current status of solar distillation, outline the general situations where it may be the best solution to water supply problems, provide a method for potential users to estimate performance and costs of current still designs in their area, to note practical problems of solar still design and operation, and to recognize possible changes in solar distillation technology and economics which may affect the applicability of the process in the future. Very good information on the design of stills is included, requiring a knowledge of basic mathematics. There is a lack of detailed plans, but construction of stills using the ideas and drawings in the book is possible. The major requirements for a solar still are simply a basin of cement or other material to catch water, and a clear covering (glass or plastic).

181.

Stop the Five Gallon Flush, Montreal, Canada: Minimum Cost Housing Group, School of Architecture, McGill University, 1973.

This report is an extensive survey of human waste disposal systems, ranging from the $7.50 Chaing Mai (Thailand) squatting plate, to the $7,000 high-tech Cycle-Let system. There are explanatory illustrations and text, which would enable the reader to construct the simpler systems on his own. 66 waste disposal systems from 14 countries are covered. Systems are divided into the following categories: infiltration (absorption and dispersion of excreta in the soil and groundwater, as in pit latrines or aqua privies); manual or mechanical removal (buckets, vacuum units, or sewage pipe networks); destruction (incinerating toilets); and decomposition (where microbiological action destroys pathogens and creates fertilizer, as in compost privies or methane digesters). Included is the Vietnamese composting privy--an effective device with widespread applications.

182.

Surveillance of Drinking Water Quality, Monograph Series No. 63, Geneva: WHO, 1976.

A comprehensive discussion of water quality surveillance including organizations and administration, laws, regulations and standards, personnel, the performance of a sanitary survey, basic tests involved in water sampling and methods of sampling, corrective actions that may be necessary, and surveillance techniques for certain special systems. This publication provides useful information on water quality that may be applicable to any country. This information relates to technical methods and does not provide cost/benefit evaluations.

183.

"Viruses in drinking water", European Standards for Drinking Water, p. 28, Geneva: WHO, 1970.

None of the accepted sewage treatment methods yields virus-free effluents, but a number of different investigations have found activated sludge treatment to be superior to trickling filters. Viruses can be isolated from raw water and from springs. Enteroviruses, reoviruses, and adenoviruses have been found in water. Of these, enteroviruses are the most resistant to chlorination. It is considered that if enteroviruses are absent from chlorinated water it can be assumed that the water is safe to drink. There must be some reservation about the virus of infectious hepatitis, since it has not so far been isolated, but in view of the morphology and resistance of enteroviruses it is likely that if they have been inactivated, hepatitis virus will have been inactivated also. In a water in which there is free chlorine, viruses will generally be absent if coliform organisms are absent. However, in a water with a high concentration of organic matter--in which chlorine would not remain as free chlorine--absence of coliform organisms would not imply freedom from viruses.

184.

"Water pollution control in developing countries." WHO Technical Report Series No. 404. Geneva: WHO, 1968.

This report provides a review of the water pollution situation in developing countries as of 1968. Considered are such factors as resource availability, health aspects of water pollution control, planning of resources, surveillance of water sources, water quality management, research and training, and the problems involved with public support.

185.

"Water pollution control." WHO Technical Report Series No. 318. Geneva: WHO, 1966.

This report discusses a variety of key issues related to water pollution control. These include: the extent and probably growth of water pollution, classes of water pollutants, effects of pollution, methods of treatment before discharge into rivers, assessment of quality of effluents, and laws related to pollution control. Recommendations for areas of future research are provided relating to a number of the above issues.

186.

Water Resources Center. The Christina Basin: The Protection of Water Resources As A Basis for Planning in Developing Areas, Neward, Delaware: Delaware University, 1972.

Example of how features of soil, topography and vegetation can be classified for use in specifying measures needed to prevent damage to soil and water. Defines effects of development and has identified measures needed to prevent undesirable effects. Determines costs and where they should be assigned. Shows virtually any land can be developed without intolerable damage to soil and water when corrective measures are applied.

187.

"Water Supplies for low-income communities in developing countries." Journal of Environmental Engineering Division, American Society of Civil Engineers, Vol. 101, No. EE5, Proceedings Paper No. 11608, p. 687-702, Oct. 1975.

In 1970, the WHO found that 86% of the rural population in developing countries were without safe water. Presented is an analysis of the potential impact of a water supply system in a poor tropical community. Considered are techniques for quantification of this impact. Special attention is paid to the water collection journey and to the anticipated improvements in community health. Useful approaches to identify specific design benefits are listed; savings in time and energy expended in water collection and improvements to health are suggested as being realistic design benefits for most situations. A classfication of water-related infections is analyzed. A comprehensive table, showing the principal features of these diseases, is included. Improvements to specific water-related infections can be used as design benefits for water supply schemes. A more rigorous approach to improving the standards of water supply facilities in developing countries is needed. An analysis of water supply impacts, particularly concerning water collection and health, can facilitate superior designs and more rational resource allocation for water supply programs.

WASTEWATER AND EXCRETA DISPOSAL

188.

Babbitt, Harold E., Sewerage and Sewage Treatment, New York: John Wiley and Sons, Inc., 1958.

This basic text on sewage disposal and treatment describes types of sewers and sewer systems and quantities of sewage. Also described are mechanical devices used in all parts of the system with a comparison of differences. Maintenance of sewers is discussed and the specifics of sewage treatment, characteristics of sewage, and the disposal of sewage. The various processes and procedures involved in treatment are elaborated such as screening, sedimentation, chemical treatment, septic tanks and Imhoff tanks, sewage filtration, intermittent sand filters and other filters, activated sludge, sludge handling and disposal, sludge digestion, drying and incineration, and also industrial waste disposal. Hazards involved are discussed and comparisons of alternative methods are presented whenever possible. This is a useful text providing practical information and basic concepts for the development of a sewage treatment system.

189.

Berg, G. "Removal of viruses from sewage, effluents, and waters." World Health Organization. Bulletin No. 49: pages 451-469 (1974).

Coagulation with metal ions is the most effective single treatment method for removing viruses from sewage and from raw waters, according to laboratory studies. Lime is the best coagulant in the rapidly viricidal high pH range. Polyelectrolytes also can sediment viruses. Rapid filtration through clean sand does not remove viruses, but filtration of coagulated effluents does, as the layering floc itself absorbs viruses. Clays and C absorb viruses to some extent, but the process is not efficient. Ultimately, disinfection should produce virus-free effluents for discharge into waters with which man may come into contact. Effluents and waters containing solids can probably be disinfected only by heat or by penetrating radiation. Waters discharged into streams should not be disinfected with anything that will injure or kill aquatic life unless the toxic products can be neutralized. Drinking waters should carry a disinfecting residue.

190.

Brodie, H.L. and Kennedy J.T. "Land disposal of livestock waste." Agricultural Engineering Release, No. 54, Environmental Series 5, Cooperative Extension Service, University of Md., College Park, 1972.

The production and waste management practices used by farmers determine the extent of water pollution caused by their animal production units. Land spreading of animal wasts is claimed to be a very effective method of preventing water pollution because of the natural treatment process in the soil. Several means of applying the principle of intercepting and controlling surface and subsurface waters are listed. Watersheds are affected a great deal more by natural pollutants than by animal wastes which are properly spread on land where erosion is controlled. Crop rotation, strip cropping, pasture improvement and the growing of crops for protective cover are the most common erosion control procedures. A list of steps to take in the prevention of pollution from land disposal of animal wastes is given. Alternative methods of land application during the fall are provided. If animal production units are properly located and managed, groundwater problems are minimized.

191.

Buras, N., "Concentration of enteric viruses in wastewater and effluent: a two year survey." Water Research, Vol. #10(4): page 295 (1976)

A two-year survey has been carried out on the wastewater and effluent of the Haifa treatment plant in order to gather information on the concentration and composition of enteric virus populations. Results showed: (1) enteric viruses were present year round in both wastewater and effluent; (2) their numbers fluctuate, being lower in winter; (3) highest numbers recorded between April and September. This paper suggests that traditional methods of wastewater treatment do not destroy the enteric viruses present in sewage.

192.

Carpenter, R.L., Coleman, M.S. and Jarman, R. "Aquaculture as an alternative wastewater treatment system." In: (eds) Tourbier, J. and Pierson Jr., R.W. Biological Control of Water Pollution, pages 215-224, Philadelphia, Pennsylvania: University of Pennsylvania Press, 1976.

Conventional wastewater treatment systems are biological to the algae removal point. An experimental system is described in which algae removal is effected (sic) by a further biological phase involving fish. The study covered a 6-cell lagoon system totaling 15.8 ha. About 1 mgd of raw domestic waste received conventional aeration in the first 2 cells. The remaining cells were stocked with channel catfish, golden shiners, fathead minnows, and Tilapia nilotica. A summer-long test produced the following initial and final mean weekly values, in mg/l: BOD_5, 184 and 6; suspended solids, 197 and 12; total N, 18.94 and 2.74; and total P, 9.01 and 2.11. Fecal coliforms were reduced from 3.05 x 10^{-6}/100 ml to 20/100 ml. (sic) The estimated fish increases in biomass included 4 to 163 lb. for golden shiners. No food other than sewage-derived nutrients was provided for the fish. Estimated total cost for the system is $0.15/1,000 gal.

193.

Caruso, P., Delphino, L. and Krigman, A. Water and Wastewater Equipment Manufacturers Association: Fourth Annual Industrial Pollution Conference. McLean, Va.: Water and Wastewater Equipment Manufacturers Association, 1976.

Sixty-three papers are presented on various phases of pollution control.

Equipment or methods covered include synthetic liners for ponds, analytical instruments, activated carbon, UV treatment of wastes, ion exchange, spray disposal, chlorine dioxide oxidation, hyperfiltration, and spray cooling. Waste treatment is considered in relation to steel mills, meat processing, the chemical industry, fertilizer plants, textiles, and synthetic rubber production. Specific pollution problems addressed include oil spill cleanup, odor and corrosion control, Ag recover, ammonia removal, the monitoring of Cl_2 at the part/billion level, and the separation of metals from complexed cyanide wastes.

194.

Chung, T.W., Culture and production of microalgae from municipal waste water. New Technology (Korea) 2 : 15 (1971)

This is a description of one method of reuse of wastewater by cultivation of algae which may then be used as a food source, primarily for livestock.

195.

Cooper, R.C. "Waste water management and infectious disease: I. Disease agents and indicator organisms." Journal of Environmental Health, Vol. #37(3): pages 217-224 (1974)

Various infectious agents (bacteria, viruses, and parasites) which are apt to be present in waste water, the problems of determining the dose of these agents, dose response considerations, and the probability of human contact are reviewed. Each of these topics are important in evaluating the public health impact of waste water reuse.

196.

Dean, R.B. and Forsythe, S.L. "Estimating the reliability of advanced waste treatment: Pt. 2." Water and Sewage Works, Vol. $123 (7): pages 57-60 (1976).

The analysis of the data used is described and related to legal requirements. Logarithmic plots of BOD, a measure of detergents, turbidity, coliform count at Luther Pass, and residual Cl at Luther Pass are also presented. If the plant performance obeys normal or log-normal statistics, there is a real probability of exceeding any finite upper limit, making the requirement that a parameter never exceed a designated value unrealistic. The decision as to how specifications are set should be based on the effects of violations and the internal cost of compliance in comparison to the external cost of the violation. Recognizing that real plants release pollutants whose concentrationa are log-normally distributed can increase the validity of extrapolations from existing data.

197.

De Jong, J. "The purification of wastewater with the aid of rush or reed ponds." In: (eds) Tourbier, J. and Pierson Jr., R.W. Biological Control of Water Pollution, pages 133-139, Philadelphia, Pennsylvania: University of Pennsylvania Press, 1976.

Experimental ditches were used for comparing the efficacies of rushes, weeds, and polyethylene fibers in purifying sewage. The aquatic plants function mainly by providing attachment sites for microorganisms that do the actual purifying, and the aquatic plants assimilate part of the N and P of the sewage. A good purification is obtained even with high loading; the bacteriological contamination is also greatly reduced. Part of the wastewater infiltrated into the soil beneath the ditches, but very little modification of the groundwater at 1-2 m was observed. The water that infiltrated was purified in the topmost layers of the soil. Retention times 10 d gave good results. Sewage treatment with rush ponds is considerably cheaper than with activated sludge-type plants.

198.

Dinges, R. "A proposed integrated biological wastewater treatment system." In: (eds) Tourbier, J. and Pierson Jr., R.W. Biological Control of Water Pollution, pages 225-230, Philadelphia, Pennsylvania: University of Pennsylvania Press, 1976.

The construction of an experimental facility at an area wastewater treatment plant is in progress for the evaluation of animals and plants in an integrated, sequenced system for water quality improvement. Pond culture units will test hyacinths, snails, lemna, scuds, insects, zooplankton, shrimp, and fish for effect on mineral content, dissolved solids, denitrification, clarification, suppression of algal growth, organic reduction, and coliform bacterial reduction.

199.

Fair, G.M., Geyer, J.C., and Okun, D.A. "Water purification and wastewater treatment and disposal." In: Water and Wastewater Engineering, Vol. #2, New York: John Wiley, 1968.

Source not referenced.

200.

Fischer, A.J. "Sanitary sewage treatment." In: (eds) Gehm, H.W. and Bregman, J.I. Handbook of Water Resources and Pollution Control, pages 481-520, New York: Van Nostrand Reinhold Company, 1976.

The unit processes and equiopment of primary treatment are explained, including screening, grit removal, sedimentation, flotation, and flocculation. The activated sludge process of biological treatment is surveyed, with operational data from some major municipal works. Other processes and hardware covered include aeration and aerators, trickling filters, oxidation ponds, odor control, and disinfection.

201.

Gehm, H.W. "Sludge handling and disposal." In: (eds) Gehm, H.W. and Bregman, J.I., Handbook of Water Resources and Pollution Control, pages 676-718, New York: Van Nostrand Reinhold Company, 1976.

The sources and types of sludges are reviewed. Sludge dewatering is studied, including thickening, conditioning, filtration, and pressure dewatering. Various equipment and processes are described for sludge incineration. Sludge digestion is briefly considered. Sludge disposal methods include lagooning, landfilling, land application, ocean disposal and use as compost and fertilizer.

202.

Gloyna, Earnest F., Waste Stabilization Ponds, Geneva: WHO, 1971.

This book discusses the usage of waste stabilization ponds for sewage treatment. The history of pond development is provided and the extent of their use internationally on all continents is reviewed. Wastewater characteristics and their relationship to biological stabilization are presented. Process design procedures such as predesign considerations, typical pond layouts, faculative ponds, anaerobic and aerobic ponds, and design recommendations are included. Disease transmission control as a factor in pond design and characteristic disease organisms are described. Finally, facilities design and operational considerations are addressed. The author suggests that waste stabilization ponds are a useful method of wastewater treatment and disposal for growing communities where both funds and trained personnel are in short supply.

203.

Hunsicker, M. and Almeida, T. "Powdered activated carbon improves anaerobic digestion." Water and Sewage Works, Vol. #123 (7): pages 62-63 (1976)

To help reduce solids settling and eliminate odors, the 9.75 mgd Norristown, Pennsylvania, activated sludge plant added 1,800 lb. of the C to each primary digester, followed by a dose of 350 lb/d thereafter. A converted 55-gal. drum was used to rapidly add the C with a minimum of dusting. After 4-5 months, operations improved significantly. Gas production increased, and odors decreased. Supernatant quality also improved. Finally, the elimination of the use of deodorant chemicals for odor control far offset any additional cost incurred in purchasing the C.

204.

Hunt, P.G. and Lee, C.R. "Land treatment of wastewater by overland flow for improved water quality." In: (eds) Tourbier, J. and Pierson Jr., R.W. Biological Control of Water Pollution, pages 151-160, Philadelphia, Pennsylvania: University of Pennsylvania Press, 1976.

Overland flow systems are a modification of land application in which the water travels over a relatively impermeable soil and the renovative action derives from plant and microbial activity. Mechanisms of removal are discussed for N, P, trace elements, and O-demanding substances. Vegetated slopes of about 8% are utilized; they normally are 150-200 ft. in length with collection channels located at the bottom. The application vol is usually < ½ acre-in/d. The use of overland flow is examined for rice fields, marsh areas, recreational areas, and combined forage grass-pulp forest systems.

205.

John, R.L. Probhakar Rao, A.V.S. and Bokil, S.D. "Harvesting of algae--a review." Indian Journal of Environmental Health, Vol. #18 (1): pages 15-25 (1976).

The mechanism of removal involved, the economics of the processes, and the usefulness of the harvested product are discussed. The main drawbacks are higher harvesting cost and low market value, but if stabilization ponds are used and the benefits are accounted for, the actual cost is less than anticipated. The favorable factors of harvesting are comparatively greater yield (12.5-150 ton/ha/yr), unlimited growing season, higher protein (41.7%-41.9%) and fat (7.0-7.2%) content, and greater control over the growth process. The adverse factors in harvesting are the small size, low specific gravity, floating morphology, and the low concentration which precludes simple sedimentation or flotation. Bringing algae to the final processed form involves initial concentration of cells from the pond effluent and dewatering and drying the slurry. The removal method based on chemical coagulation and flocculation is the most promising. The primary settled mass of algae is about 0.5%-2.5% solids content. Dewatering produced ≥ 8%-10% solids content achieved by centrifugation, gravity, or vacuum filtration. The slurry is further dried to a solids level of ≥ 88%-90% by sun drying or dewatering on sand beds or kiln drying. The concentrated algae is usually processed with other grains at a 10% mixture.

206.

Krige, R.P. "A study of modern methods of municipal waste utilization and conversion to compost." Water Research Division, National Chemical Research Laboratory, South African Council for Scientific and Industrial Research (reprinted from Municipal Affairs, September to December 1955).

This study is concerned with the technicalities involved in the economic processing of organic wastes into compost for rehabilitation of impoverished soils in South Africa. Part I of the report deals briefly with the general attitude of the public toward refuse and other organic wastes, with impressions regarding soil fertility and farming practices in general, and with the demand for compost. Of the countries visited only those which had developed a reason for soil consciousness were interested in organic wastes as soil conditioners. The Dutch and Danes were the only ones to utilize compost for soil improvement to any extent. In the U.S. the hygienic-disposal aspect is first and foremost of concern. The compost product receives little attention, and its benefit to the soil is a secondary consideration. An explanation and detailed description of installations visited constitutes Part II of the report. Part III is concerned with modern trends in composting techniques.

207.

Kugelman, I.J. "Status of advanced waste treatment." In: (eds) Gehm, H.W. and Bregman, J.I. Handbook of Water Resources and Pollution Control, pages 593-636, New York: Van Nostrand Reinhold Company, 1976.

Wastewater characteristics are surveyed and conventional treatment technology is reviewed. The following topics are treated: microstraining, deep bed filtration, tube settlers, P removal, biological denitrification, breakpoint chlorination, ammonia removal by air stripping, selective ion exchange, activated carbon treatment, ozone oxidation, pure O_2 activated sludge, electrodialysis, and reverse osmosis.

208.

Larson, W.E., Gilley, J.R., and Linden, D.R. "Consequences of waste disposal on land." Journal of Soil and Water Conservation, Vol. #30 (2): pages 68-71, 1975.

This paper states that organic wastes can be used safely and effectively to increase soil productivity if proper precautions are taken concerning heavy metals, toxic chemicals, nitrate leaching, erosion losses, and undesirable odors. Average composition is given for animal wastes, sewage sludge and secondary sewage effluent. Farm manures contain the major nutrients in the most correct proportion for soil fertilization. They also decrease bulk density, increase aggregate stability, increase water intake rates, and help control soil erosion. Sewage sludges are effective in reclaiming such productive lands as mine spoil banks, abandoned garbage dumps, and sanitary landfills. There is also evidence that crop yield increases as a result of irrigation with treated municipal waste water. The authors claim that proper waste management measures must be taken to protect the environment when applied at crop use rates and with proper soil management, most organic wastes present no serious environmental hazards and should be considered a resource that agriculture can very well use.

209.

Lehmann, E.J. "Ocean waste disposal. A bibliography with abstracts." U.S. National Technical Information Service. Publication NTIS-WIN-74-062, 1974.

Abstracts which were retrieved by the NTIS on-line search system are provided for 131 research reports. The topics include ocean disposal of sewage, sewage sludge, and dredged material. Some reports on ecological effects, pollution of the New York Bight, and the disposal of radioactive wastes, brines, and industrial wastes are also covered. No studies on discharge of heated effluents are included.

210.

Lehmann, E.J. "Sewage effects in marine and estuarine environments. A bibliography with abstracts." U.S. National Technical Information Services. Publication NTIS-WIN-74-047, 1974.

Abstracts are presented of 112 research reports on the effects of sewage effluents and sludge on marine and estuarine environments, especially on their ecology. Topics cover the effects on marine plants and animals, problems due to ocean dumping, dispersion studies and water chemistry.

211.

Minton, G.R., and Carlson, D.A., Effects of lime addition on treatment plant operation. *Journal of the Water Pollution Control Federation*, Vol. #48(7): page 1697 (1976).

The effects of lime addition on a treatment plant are evaluated and the author reports that the addition of lime to raw wastewater will significantly affect the operation of an existing treatment plant. Suspended solids and oxygen demand in primary effluent will decrease. The decreased organix loadings will benefit an overloaded process and in some cases may promote nitrification. The quantity and quality of sludge produced will be altered. Best dewatering results are obtained with either thickening or centrifuging; less certain results are obtained with vacuum filtration and sand bed drying. Biological digestion is of doubtful value for solids reduction, and incineration also is less effective. Problems may result in ultimate disposal of raw solids. This article is not particularly useful for developing countries and especially not for rural communities unless they already have well-developed treatment facilities.

212.

Okun, D.A. and Ponghis, G., *Community Wastewater Collection and Disposal*. Geneva: WHO, 1975.

This publication elaborates many of the specific concerns in wastewater management for any community. Included are the significance of collection and disposal systems, financing and sources of funds, administration, hydraulics, wastewater conveyance, planning collection systems, pumping stations, quality and treatment requirements, treatment processes, wastewater reclamation, handling and utilization of solids, and plant design. The basic concepts provided are most useful for urban areas although, depending on the level of development, they may also be relevant to rural communities. Specific technologies are not evaluated or described.

213.

Parhad, N.M. and Rao, N.U. "Decrease of bacterial content in different types of stabilization ponds." *Indian Journal of Environmental Health*, vol. #18 (1): pages 33-46 (1976).

Experimental investigations were carried out on 3 stabilization ponds in Nagpur City, India. The Bezonbagh earthen pond is fed by domestic waste (576 lb./acre) with a 2-d detention period in summer and a 4-d detention period in winter. The National Environmental Engineering Research Institute (NEERI) pond is a full-scale sewage treatment facility (102.5 lb./acre/d) consisting of 2 cells in series with a 12.3-d detention period. The Bhandewadi pond consisting of 3 earthen cells with a 7-d detention period is fed by city sewage (297.3 lb./acre/d) Of the 3 oxidation ponds, the Bhandewadi pond gave the highest percentage reductions in BOD (90.8%-96.6%) and indicator bacteria (>99%). The BOD reduction in the Bezonbagh pond was higher (77.6%) than the NEERI pond (55.5%-73.6%) due to the low BOD of the influent and the longer detention period than optimum in the NEERI pond. The reduction in total bacteria, coliforms, E. coli, and Entercocci in the Bezonbagh pond did not differ significantly with the 4-d detention period and the 2-d detention period. All the ponds showed a greater percentage reduction in MPN of coliforms, E. coli, and entercocci as compared to the total bacterial population.

214.

Peel, C. "The problem of excremental disease in tropical Africa." *Journal of Tropical Medicine and Hygiene*, Vol. #70 (6): pages 141-152 (1967)

This paper discusses certain disease problems associated with exposure to fecal materials in tropical Africa. The primary focus is on helminthic and protozoan parasitic diseases. Sanitation problems and their role in the transmission of these diseases is discussed. Pollution of water, soil and food by these organisms and their resultant transmission to humans is discussed. The relationship of improper refuse disposal to these problems is also mentioned.

215.

Priestley, G. "Algal proteins." In: (eds) Birch, G.G., Parker, K.J., and Worgan, J.T. *Food From Waste*, pages 114-138, London: Applied Science Publishers, 1976.

The increased production of waste materials in agriculture and in urban areas coupled with an increased need for high-grade proteins suggests the application of algal culture techniques for waste recycling. The semicontinuous operation of lagoon culture of algae with optimum catch techniques using sewage or N- and P-rich wastewaters as primary substrate can produce higher dry weight yields of superior protein quality than can higher plants under similar conditions. A simple, relatively nonturbulent system relying on evaporative cooling eliminates many of the problems previously encountered with algal culture, but problems are still encountered in separating the product from the culture which is done in primary, secondary, and tertiary stages. Using filamentous algae, however, eliminates the primary separation stage. Crude algae can be consumed by humans only on a small scale unless it is fractionated by mechanical, chemical or enzymic methods of disruption. It must also undergo fat removal, decolorization, and texturization. Until economic techniques for these processes are developed, an extra link in the food chain, e.g., to produce beef protein, is the best way of upgrading the crude algal produce into an acceptable form.

216.

Ruckelshaus, W.D. "An environmental overview." In: (eds) Tourbier, J. and Pierson Jr., R.W. *Biological Control of Water Pollution*, pages 31-36, Philadelphia, Pennsylvania: University of Pennsylvania Press, 1976.

A major component of our environmental problem lies in our misuse of technology.

An example is the large amount of water expended in the simple operation of transporting human waste to the treatment plant. Another example is our spending of $9 billion/year for the construction of classical sewers and treatment plants, and only $20 million/year on the development of alternate approaches to treatment. The result is to lock us onto a decades-old technology. A 3rd example was in our allowing the automobile to get environmentally out of hand. Reasons in our failing to apply new technology to environmental problems include psychological inertia, a communications gap between the scientist and the administrator, and a recent philosophical reaction against technology. There is a tendency to oversimplify approaches to pollution problems to the point of being quite unrealistic--a recent court order in Los Angeles in connection with the Clean Air Act if literally carried out would have removed 93% of the automobiles from the road. What we need is not less technology, but a wiser control of that which we do have.

217.

Rudolfs, W., Falk, L.L., and Ragotzkie, R.A. "Literature review of the occurrence and survival of enteric, pathogenic, and related organisms in soil, water, sewage and sludges, and on vegetation." Sewage and Wastes, Vol. #22: pages 1261-1417 (1950).

Source not referenced.

218.

Shipman, H. "Implications of biological control of water pollution proposals to the developing countries." In: (eds) Tourbier, J. and Pierson Jr., R.W. Biological Control of Water Pollution, pages 329-332, Philadelphia, Pennsylvania: University of Pennsylvania Press, 1976.

The biological controls of most immediate relevance to developing countries are those dealing with groundwater and with stabilization ponds. Groundwater surveys are needed in many developing countries for the location and development of such resources whenever feasible. The advantages of stabilization ponds include low cost and equipment requirements and simplicity of operation. Stabilization ponds are the method of choice for cities with access to the land needed. The combined production of fish and other aquatic forms with the agricultural use of pond effluents offers possibilities for both protein production and improved agricultural productivity.

219.

Shuval, Hillel I. "Health factors in the reuse of waste water for agricultural, industrial and municipal purposes." In: Problems in Community Wastes Management, Public Health Paper No. 38, pages 76-88, Geneva: WHO, 1969.

Waste water, after adequate treatment, can be recycled for use in agriculture and industry and, in certain circumstances, may in time become available for municipal and domestic use if a particular high degree of treatment with adequate safeguards is provided. In planning programmes for the utilization of waste water, the public health implications must be given careful consideration, since physical, microbiological or chemical pollution may place limits on the use of reclaimed water.

220.

Spangler, F., Sloey, W. and Fetter, C.W. "Experimental use of emergent vegetation for the biological treatment of municipal wastewater in Wisconsin." In: (eds) Tourbier, J. and Pierson Jr., R.W. Biological Control of Water Pollution, pages 161-171, Philadelphia, Pennsylvania: University of Pennsylvania Press, 1976.

Laboratory experimentation established that beds of blue flag, softstem bulrush, and hardstem bulrush reduced the BOD, COD, and P of unchlorinated primary effluent. Pilot plant investigations with basins of these plants achieved the following reductions in secondary activated sludge effluent: BOD_5, 87%-92%; turbidity, 77%-91%; coliform bacteria, 90%-99.7%; nitrate, 47%-59%; and suspended solids, 17.3%-68%. Measurements were taken around a natural cattail marsh in which was located the outfall from a wastewater treatment plant. During its travel through the marsh the water underwent reductions of 90% in BOD, 35% in COD, 67% in organic phosphate, 67% in total P, 78% in turbidity, and 97% in coliform bacteria. The treatment effect of aquatic macrophytic systems is associated with microflora in the plant substrate rather than with the plants themselves.

221.

Stander, G.J. and Miering, P.G. "Employing oxidation ponds for low-cost sanitation." Journal of the Water Pollution Control Federation, Vol. #37 (7): pages 1025-1033 (1965).

Source not referenced.

222.

Stone, R. "Water reclamation: Technology and public acceptance." American Society of Civil Engineers, Environmental Engineering Division, Vol. #102 (3): pages 581-594 (1976).

In each of 10 Southern California communities, 100 households were telephone surveyed to obtain public attitudes towards 13 potential reuses of wastewater. Correlations of public attitudes were analyzed, as well as reasons for reluctance to fully endorse wastewater reuse. The attitudes of industrial management, government officials, and water resource experts to wastewater reuse were also sampled and assessed. Results show that the public is ready for large-scale wastewater reuse for nonbody contact purposes, and to a lesser extent, for body contact purposes."

223.

Wagner, Edmund G., and Lanoix, J.N., Excreta Disposal for Rural Areas and Small Communities, Geneva: WHO, 1958.

This publication considers the public health, social and psychological implications of excreta disposal. The privy method of disposal is discussed with numerous examples detailed, such as the pit privy, the aqua privy, and water-seal latrine, etc. Water-carried methods of excreta disposal for rural areas are discussed. The planning of excreta disposal programs and training and function of the sanitation staff are described. Some of the basic excreta disposal methods included in this text may be useful to the rural communities of developing nations.

224.

Warshall, Peter, Septic Tank Practices, Bolinas, California, 1976.

This informative and inspirational manual comes from a small California community which successfully implemented alternative waste "disposal" systems by public initiative, thus preventing its waterways from becoming a sterile sewage lagoon. Systematically presented are accounts of life-giving resource recycling schemes (and where to procure plans, as in the case of the effective Farallones Institute Composting privy--see review). The focus is on septic tanks, emphasizing the natural ability of the soil to purify and absorb "waste water". This volume complements ITDG's Water Treatment and Sanitation and the privy options included in Cloudburst 1 and the VITA Village Technology Handbook. Excellent sections on biology and maintenance, although it lacks the concise working details and plans of WHO's Excreta Disposal for Rural Areas and Small Communities.

225.

Williamson, D. and Mann, H., Water Treatment and Sanitation: Simple Methods for Rural Areas, Intermediate Technology Development Group, 1973.

The purpose of this handbook is to put together in a simple and logical form various aspects which must be considered when investigating the development of a water supply and sewage disposal scheme for a small community, and to make known the possibility of applying low-cost techniques. It is not intended as a textbook for engineers, although they may find some sections useful for rapid reference, but is intended for technicians, leaders of rural communities, administrators of schools or hospitals and others who wish to develop a water supply and sewage disposal scheme for their own use. Many of the methods in this handbook are based on the standard practices used in developed countries. They are, however, adapted to suit rural tropical conditions, and much material has been included which has been derived from experience in tropical areas drawn from a variety of sources, and is not normally found in standard temperate-zone practice.

Includes chapters on selection of source and simple water testing; water supply; water treatment; excreta disposal; sewage treatment; temporary and emergency treatment. Charts, graphs and simple methods for roughly calculating water demand, flow measurement, and pump heads are included, as are simple drawings of a variety of water system equipment: sand filters, pumps, privies, water seal toilets, and simple sludge treatment ponds. A glossary of technical terms is included, as are drawings and a bibliography. One weak point is that some of the chemical and biological analysis suggested to determine water quality may be difficult to perform in some areas where litmus paper and similar testing equipment are not available. Red cabbage, for example, turns one color when water is basic and another color when water is acidic. There is a need for identification of a range of fruits and vegetables that change color under these conditions. This is still one of the two best books on the subject. Highly recommended.

226.

Wolverton, B.C., Barlow, R.M. and McDonald, R.C. "Application of vascular aquatic plants for pollution removal, energy, and food production in a biological system." In: (eds) Tourbier, J. and Pierson Jr., R.W. Biological Control of Water Pollution, pages 141-149, Philadelphia, Pennsylvania: University of Pennsylvania Press, 1976.

Under favorable conditions 1 acre (0.4 ha) of water hyacinths has the potential for removing from sewage effluent 1,591 kg/yr of N, 364 kg/yr of P, 68 kg/72 hr of phenol, and 120 g/24 hr of trace heavy metals. The removal capabilities of water hyacinths and alligator weeds are summarized for Cd, Pb, Hg, Ni, Ag, Co, and Sr. The effects of water hyacinths and alligator weeks on raw sewage and secondary effluent are tabulated for N, P, suspended solids, BOD_5, and pH. One acre of water hyacinths has the potential of producing 240 kg/d, or 63,640 kg/yr, of dry plant material when grown in a favorable medium such as sewage effluent. One harvesting scheme envisions gathering this material at regular intervals, chopping it into 2.5-cm pieces, and utilizing it for the production of fuel gas. Investigations on the processing of the residual sludge into fertilizer are planned. Alternatively, the harvested plant material might be suitable for the production of animal feed.

227.

Composting Privy (Technical Bulletin No. 1), Occidental, California: Farallones Institute, 1974.

The Farallones Institute Composting Privy has proven successful in its rural California trail sites. Human waste is aerobically composted in twin chambers for a 1-year period--then it can be safely used in a garden. The elegant design is straightforward, virtually odor free, low-maintenance, of simple yet durable construction and can be built by amateur builders for less than $100 (in the U.S.--certainly less in developing countries). Uses common tools and materials. This system requires a few minutes each month to turn the compost pile. By providing on-site treatment of human waste and organic household waste without the use of water or plumbing, the flush toilet, septic tank and garbage can are eliminated, and valuable nutrients and humus are returned to the soil. Besides the hygienic factors, this composting privy allows the use of the squatting position, long considered the most comfortable and healthy posture for defecation. A note of caution: this design is intended for aerobic conditions (that is, where there is free circulation of air through the pile). It cannot deal with an overload of moisture. Thus a modification must be found for conditions in Southeast Asia, where anal cleansing by water is the standard cultural practice.

228.

"Sludge disposal: a case of limited alternatives." Deeds and Data, P. D-1--D-4, Dec. 1971.

A panel discussed alternatives for sludge disposal. Some treatment plants can transport sludge to crop lands. Guidelines can be written for heated anaerobically digested sludge to be applied at rates up to 100 dry tons/acre for any soil type. Cadmium, lead, mercury, copper, and chromium in the sludge do not appear to be detrimental to crops. There are also extremely fes pathogen problems. Other disposal methods are incineration, ocean disposal, and lagooning. Very little survey work cost data has been published on various methods of sludge disposal. It is obvious that much more experimentation and research is needed in order to solve the sludge disposal problem. This paper may be useful for any community that has or is planning to have a waste treatment plant.

229.

World Health Organization, Technical Report Series, No. 541, "Disposal of community wastewater. Report of a WHO Expert Committee." Geneva: WHO, 1974.

The Committee reviewed the most important problems of community wastewater disposal in developing countries. The report examines the effects on public health, cultural and socioeconomic conditions, and the environment in general, of the present inadequacies in wastewater disposal, emphasizing that the situation is steadily deteriorating because of accelerating population growth, urbanization, and industrialization. The technical problems inherent in wastewater collection and disposal are discussed and ways of overcoming present deficiencies are suggested. Particular importance is attached to the problems of sanitation in urban fringe areas, where the vast influx of migrants from rural areas has created serious public health problems. Among the points to which the Committee drew particular attention was that wastewater collection and disposal should be considered in the initial planning of settlements and should be given a high priority in, and be coordinated with, land use plans, town planning, housing, and water supply.

SOLID WASTES

230.

Birch, G.G., Parker, K.H. and Worgan, J.T. (eds) Food From Waste, London: Applied Science Publishers, 1976.

Papers are presented on various aspects of the direct recovery of protein from industrial wastes in meat, dairy, and vegetable processing industries and the preparation of foods by growth of yeasts, fungi, and algae on waste materials. Although the production of protein is emphasized, the recovery of oils, fats, and carbohydrates is also discussed. Other topics include the world food problem, a nutritional and toxicological evaluation of novel feed, and the socioeconomic implications of producing food from waste.

231.

Brown, D.E. and Fitzpatrick, S.W. "Food from waste paper." In: (eds) Birch, G.G., Parker, K.J. and Worgan, J.T. Food From Waste, pages 139-155, London: Applied Science Publishers, 1976.

The cellulosic content of paper and cardboard varies widely from the value associated with pure timber pulp, depending on the degree of additive and recycle that it contains. The natural crystalline cellulose consists of a complex coiled polymer of 1-4 linked glucose molecules. These molecules can be utilized if they can be made available by hydrolysis. Suitable microorganisms containing enzymes which can degrade the cellulose can be cultured directly on the waste paper to produce either animal feedstuffs or compost fertilizers. Alternatively, the cellulose can be hydrolyzed by either chemical or enzymic methods to yield a glucose liquor which can be used either as a fermentation energy source for the production of proteins, organic acids, and alcohol, or separated for direct consumption. The problems involved in such technology are discussed.

232.

Cimino, J.A. "Health and safety in the solid waste industry." American Journal of Public Health, Vol. #65 (1): Pages 38-46 (1975)

Solid waste disposal is one of the most hazardous occupations in the U.S. Almost no good epidemiological information is available on the subject. There are obvious preventive measures which can and should be undertaken immediately. These include the following: safety education courses should be offered, starting with top management personnel, and extending to all supervisory and field personnel; equipment must be evaluated and made to fit the workers' capacities; the work environment must be continuously evaluated and tested for hazardous conditions. This paper is not very relevant to the developing countries.

233.

Ellis, H.M. "A new appraisal of the solid-waste problem." In: Problems in Community Wastes Management, public Health Paper No. 38, pages 21-46, Geneva: WHO, 1969.

This article discusses the broad problem of solid waste management, including population, land shortage, changes in character of wastes, and lack of adequate data on health, economics, labor, etc. Major issues emphasized are esthetics, public relations, public health concerns, economics and finance, present systems of handling and disposal, proposed new technologies, planning, administration and management, and education and training. This paper may be useful in understanding the magnitude of solid waste management. It is not particularly geared toward developing countries. However, its principles may be applicable to most urban communities.

234.

Flintoff, F. "Western solid wastes management technology in relation to tropical and developing countries." Institute of Solid Wastes Management: 78th annual conference, page 18, 1976?

Global differences in the solid waste problem are analyzed in terms of waste quantity and character, climate, economics, technical resources, social and religious constraints, and urban character. The phases of refuse storage, collection, and disposal are examined. The main criterion of refuse collection efficiency in poorer countries is vehicle productivity; at least 10 tons/vehicle-day is desirable. European manual street sweeping methods and equipment would be advantageous for most countries. Controlled landfill is suitable for direct application in arid regions, but research is needed to develop appropriate techniques for wetter climates. A vast training program for graduates and technicians is needed worldwide.

235.

Frankel, S. "Working towards a village technology: Recycline Waste." Papua New Guinea Medical Journal, Vol. #18 (1): pages 21-31 (1975).

An account of the construction of a hospital waste digester. This paper may be useful as an example of the integration of recycling into a rural system.

236.

Gilbertson, Wesley E. "Present and future trends in municipal disposal of solid wastes." In: Problems in Community Wastes Management, Public Health Paper No. 38, pages 9-20, Geneva: WHO, 1969.

This paper provides a review of the solid waste problem; that adequate solutions to storage, collection, treatment, conversion, reuse, and disposal are still needed. A discussion of quantities and characteristics of solid wastes is presented. Current methods of storage, collection, treatment, disposal and reuse are discussed and a systems approach to future planning is recommended. This report is not specifically oriented to developing communities, however, the basic principles and many of the technologies may be worthy of consideration.

237.

Golueke, C. Solid Waste Management: Abstracts and Excerpts from the Literature. U.S. Department of Health, Education and Welfare, Public Health Service, Envionmental Health Service, Bureau of Solid Waste Management, Public Health Service Publication No. 2038, 1970.

This publication contains abstracts and excerpts from the literature on solid waste management. The topics covered include management, collection and transport, disposal methods such as sanitary landfill, incineration, composting and other special methods, effects on air and water pollution, and a section on agricultural and food processing wastes. Most of the articles may not be relevant to developing nations at this time. Some articles, however, do provide background on those technologies considered "basic" to solid waste management.

238.

Golueke, C.G. Solid Waste Management: Abstracts and Excerpts from the Literature. U.S. Department of Health, Education and Welfare, Public Health Service, Environmental Health Service, Bureau of Solid Waste Management, Public Health Service Publication No. 2038, 1970.

This publication contains abstracts and excerpts from the literature on solid waste management. The topics covered include management, collection and transport, disposal methods such as sanitary landfill, incineration, composting and other special methods, effects on air and water pollution, and a section on agricultural and food processing wastes.

239.

Gotaas, H.B. Composting: Sanitary Disposal and Reclamation of Organic Wastes, Geneva: WHO, 1956. (Monograph series, No. 31).

Source not referenced.

240.

Gotaas, H.B., McGauhey, P.H., and Golueke, C.G. "Reclamation of Organic Wastes by Composting" (Paper - No information on the occasion), 1953.

The article begins with a brief history of the composting process. Fundamental concepts of composting are explained, as are the various methods used throughout the world at this time. The partially aerobic process of composting requires little machinery and has been widely used in China, India, and South Africa. Many European countries have used a partially mechanized process. A fully aerobic process involving a great amount of equipment has been tried in the United States, Holland, and Central America. The value of the fully composted end product varies, depending on the type of agricultural situation in which the plant is located. If the use of compost is the basis of survival for the farmer, then the compost will have a good market. If it is just one of many available fertilizers in an area of fertile land, the value will go down, making the economic feasibility of the composting process questionable in that area. The article goes into detail on public health aspects of composting, current in 1953. It suggests that if a normal temperature range (70° to 75°C) is maintained, and the plant is kept clean and free of litter, then no problems will arise from rodents, flies, or bacteria.

241.

Imrie, F.K.E. and Righelato, R.C. "Production of microbial protein from carbohydrate wastes in developing countries." In: (eds) Birch, G.G., Parker, K.J., and Worgan, J.T. Food From Waste, pages 79-97; London: Applied Science Publishers, 1976.

The process is based on the fermentation of the carbohydrate, or other organic materials, to yield single-cell protein (SCP) or ethanol plus SCP. The organisms used must be nontoxic and have broad substrate specificity, high growth rate, high carbohydrate conversion efficiency, growth at temperatures 35°C and at extremes of pH, simple recovery from fermentation, and high protein content. The filamentous molds Aspergillus niger and Fusarium sp, have these properties. Waste materials suitable for the growth of these microbes can be classified as solid or semisolid wastes such as spoiled fruit, carob pods, date waste and molasses, and low-concentration wastes such as olive and palm oil process water, corn steep water, and canning wastewater. Apparatus for the treatment of these wastes consists of a tank in which a slurry or extract of the waste is prepared, a fermenter with a stirrer and an air compressor, and a rotary vacuum filter. With some process modification, watery effluents can also be treated to produce SCP. The process is economical if it can be used for most of the year and labor costs are low.

242.

Livshutz, A. "Production and utilization of compost in subtropical countries." International Research Group on Refuse Disposal, English Translation by U.S. Department of Health, Education and Welfare. IRGR Information Bulletin 7, page 1, July, 1959.

The application of compost to a soil brings about a reduction in irrigation requirements by increasing the moisture-holding capacity of the soil. With the use of compost, the need for irrigation water can be reduced by 10 percent, thus permitting a 10 percent expansion in extent of areas under irrigation. Much compost has been used in Israel in citrus groves, vineyards, and in growing bananas, potatoes, and strawberries. In 1958 a total of 12,000 m^3 were used in citrus groves alone. Two plants were in operation in Israel in 1958. In one of the plants refuse accumulated for many years is stacked in heaps about 4m high. Compost from this plant contains some glass and china, nails and other metal pieces. It therefore cannot be used in gardens. However, it is good for use in vineyards and orchards. Refuse is presorted in the second plant. The presorted refuse is passed through a Door-Oliver rasping machine and is composted in windrows. The windrows are turned 4 to 6 times during the compost period. Sludge is added to the incominb refuse to give a moisture content of 50 percent to 60 percent. Ballistic and magnetic separators refine the completed compost.

243.

McCauhey, P.H. and Golueke, C.G. "Composting of municipal refuse." Unpublished Paper, Sanitary Engineering Research Laboratory, University of California, Berkeley, 1953.

The article devotes three pages to the historical development of the art of composting and to a description of the different methods of composting practiced throughout the world. It then explains the fundamental aspects of the composting process, which are: 1. Segregation: noncompostable materials are separated from the refuse. 2. Grinding: refuse is shredded to pieces about 1-inch in size to make the material homogenous, more susceptible to bacterial invasion, and to give it a beneficial initial aeration. 3. Stacking: refuse is stacked in windrowed piles trapezoidal in cross section, 8-10 ft. at the base, 5-6 ft. in height. 4. Turning: aeration is provided by turning to bring about uniform decomposition. (A recommended turning schedule is given in the article). 5. Final Grinding: for sake of appearance, the refuse is ground to a particle size small enough to pass through a 3/8-inch screen. The biological aspects of the process are described, as well as economic considerations. It is doubtful that composting will make refuse disposal profitable.

244.

Meyer, Judith G. "Renewing the soil." Environment, Vol. #14 (2): pages 22-23 (1972)

This review provides a "state-of-the-art" of the practice of solid waste composting. A discussion of existing composting plants is provided, detailed reasons for many failures. The ecological benefits of composting are elaborated as well as costs of maintaining a composting plant and benefits to be gained from marketing compost.

245.

Payne, J. "Energy recovery from refuse--state-of-the-art." American Society of Civil Engineers. Environmental Engineering Division. Journal, Vol. #102 (2): pages 281-300 (1976).

Major recent developments in the technology associated with energy recovery from the municipal solid waste stream are presented. The quantity of refuse generated in the U.S., its energy content, and its availability for utilization are reviewed. The methods already proven and under development for the conversion of refuse to stream, solid fuel, liquid fuel, gaseous fuel, and electricity are described in general terms and are further illustrated by detailed accounts of recovery systems employing the principles of methane recovery from sanitary landfills. A brief analysis is given regarding the effects of material recovery on the potential energy available in the waste stream.

246.

Pirie, N.W. "Food from waste: Leaf protein." In: (eds) Birch, G.G., Parker, K.J. and Worgan, J.T. Food From Waste, pages 180-195, London: Applied Science Publishers, 1976.

Crops grown primarily as sources of leaf protein (LP) can be grown on land unsuitable for other crops. Many agricultural by-products could also be utilized in LP production. Sugar beet tops and potatot haulm in the United Kingdom are each possible sources of 50,000 tons of LP; and while other vegetable wastes would be difficult to collect, they could also be utilized as LP sources. The potentialities of tropical by-products have been less fully explored, but water weeds are an immense potential source of LP. Their exploitation would also diminish eutrophication and partly replace the present expensive control methods. LP extraction yields a partly dewatered fiber containing 1%-2% N and a whey containing most of the leaf's soluble components. The former, which can be economically dried, it cattle fodder; the latter is used as a substrate on which microorganisms can be grown or a source of irrigation water. This production of LP should become more commonplace as the importance of circumventing waste gains recognition.

247.

Rolfe, E.J. "Food from waste in the present world situation." In: (eds) Birch, G.G., Parker, K.J. and Worgan, J.T. Food from Waste, pages 1-7, London: Applied Science Publishers, 1976.

The oil crisis, the balance of payment crisis, unemployment, inflation, the energy crisis, and the shortage of fertilizers and water must all be considered in attempting to solve the world's food crisis. One new approach is the factory production of protein. Cellulose from waste paper can be used as an energy source for microorganisms to synthesize fat or convert inorganic N into protein. Wastes from agriculture, effluents from food factories, and residues from food processing plants all have potential for conversion into food. Other residues can be converted into animal feedstuffs. Wastes and residues unsuited for these uses may be converted by microorganisms. Since foods from microbial biosynthesis require extensive clinical and toxicity feeding tests before they are given to humans, their use as animal feed is more feasible. Organic wastes can also be used as animal feeding stuffs if they are properly processed and free of pathogens. Unfortunately, it will be difficult to implement these schemes in the underdeveloped areas where additional food is needed most.

248.

Tannenbaum, S.R. and Pace, G.W. "Food from Waste: An Overview." In: (eds) Birch, G.G., Parker, K.J. and Worgan, J.T. Food From Waste, pages 8-22, London: Applied Science Publishers, 1976.

Direct human food production by fermentation of most waste materials is unlikely at present due to the problem of meeting safety requirements. Feed production is more likely, and schemes for fermentation of waste to animal feed ingredients are discussed. Economics is the overriding factor in the decision to implement any process. Although many waste streams appear to have zero or negative costs, there are often hidden costs in additional processing necessary to prepare the material for fermentation. Another significant consideration is the availability of raw material with respect to quantity and distribution in time. These economic factors are reviewed for a number of waste processing proposals with a view towards generating a unified approach to the problem.

249.

Committee on Solid Wastes, American Public Works Association. Refuse Collection Practice, Chicago, Illinois: Public Administration Service, 1966.

This is a basic technical textbook on collection practices. The major emphasis is on truck collection principles and techniques. A discussion of service requirements using existing practices is provided. The methods provided are primarily well accepted, non-innovative.

250.

Joint Commission on Rural Reconstruction. "Compost Studies at the Pingtung Experimental Plant" Report - Organic Wastes Section, Taiwan Institute Environmental Sanitation Provincial Health Administration Tapei, Taiwan, China, December, 1959.

A remedy to the shortage of green manure acreage in Taiwan was urgently needed. To solve this rather serious problem, a pilot compost plant was set up in

Pingtung City. Following these experimental studies, a full-scale forced-air bin-compost plant of 25 tons capacity per day was constructed. The plant was constructed as an experimental plant with a number of objectives in mind. The 38-page booklet goes into great detail in the presentation of data on the biological aspects of the composting process. Graphs and charts are presented. A comparison is made of data concerning three different methods of composting, namely forced-air aeration, turning of windrowed piles, and a control compost that was stacked, but not turned. A detailed discussion is included on the economic considerations of the operation. Proceeds from the sale of the compost almost equalled the total annual costs of operation. The description of plant setup is explained. A comparison of the cost of hand turning with that of forced-air aeration shows that the forced-air method is more economical in that it costs only about 60 percent that of turning.

251.

"Make Compost in 14 Days." Pamphlet by Organic Gardening and Farming, Rodale Press, Department C, Emmaus, Pennsylvania.

Instructions are given for making compost on a "backyard" scale. The instructions cover ten categories, viz., location of operation, collection and assemblage of materials, use of power equipment, operation without power equipment, improvement of the value of compost, the watering and turning processes, mistakes to avoid, how to use compost, and sheet composting. A list of some common materials that make excellent additions to the compost heap is given. It contains instructions on how to use compost.

252.

"Sanitary effects of urban garbage and night soil composting." Chinese Medical Journal in English, Vol. #1 (6): pages 407-412 (1975).

This study investigates the effects of composting to find simple but reliable criteria for sanitary evaluation of composting and to provide scientific data for promotion of this method and for regular supervision and inspection. The information provided may be useful in the decision-making process of establishing a solid waste disposal system.

253.

"Solid wastes disposal and control." WHO Technical Report Series No. 484. Geneva: WHO, 1971.

Solid wastes management is detailed in this report. The effects of solid wastes on health and welfare are evaluated and special problems associated with developing and industrialized countries are discussed. The present knowledge and technology regarding sources, handling, treatment, recycling and final disposal are described. The planning and operation of solid wastes systems are detailed and guidelines for policy and action are provided.

254.

U.S. Environmental Protection Agency. Solid Waste Management in Residential Complexes, Washington, D.C.: Government Printing Office, 1971.

This review examines the "state-of-the-art" of methods of solid waste collection. Technologies, costs and applicability to different types of development are provided. An exploration is presented of some innovative methods of waste collection. Proposals for these installations are described. The impacts of different methods of treatment are examined; not emphasizing recycling.

255.

WHO Expert Committee on Solid Wastes Disposal and Control. WHO Technical Report Series No. 484, Geneva; WHO, 1971.

Source not referenced.

PESTICIDES, PESTS, AND PEST CONTROL

256.

Aldrich, Franklin D. and Gooding, Judith F. "Pesticides." In: (ed) Newberne, Paul M. Trace Substances and Health, A Handbook, Part 1, pages 159-243, New York: Marcel Dekker, Inc., 1976.

This paper describes the major issues relevant to pesticides and health. The history of pesticide use is provided. Biological properties of selected pesticides are described and pesticide interactions are detailed. Included are analytical methods for the determination of pesticide levels and a brief discussion of diagnosis and treatment in pesticide poisoning. This paper provides an in depth, current evaluation of the relationships between pesticides and health proposed to date. It may be useful as a background document in this area.

257.

Bakir, F., et.al. "Methylmercury Poisoning in Iraq: An inter-university report." Science, Vol. #181: pages 230-241 (1973).

This paper discusses a very large outbreak of methylmercury poisoning in Iraq resulting in 6.530 cases and 459 deaths. The incidents have been associated with ingestion of seed cereals treated with organic mercury as a fungicide. Ingestion occurred in spite of labelling on containers and the coloring of the cereal. The results have been attributed to ignorance and the shortage of available grains for human and animal consumption. This case study provides an example of a critical problem with some possible solutions.

258.

Bang, Y.H., Sabuni, I.B., and Tonn, R.J. "Integrated control of urban mosquitoes in Dar es Salaam using community sanitation supplemented by larviciding." East African Medical Journal, Vol. #52 (1): pages 578-588 (1975)

An integrated control method for the control of 3 types of urban mosquitoes and the housefly, using the manpower already available for community sanitation, supplemented by larvicidal application, is evaluated in the Magomeni community of Dar es Salaam. This paper presents a method of integrated pest control that may be applied, after consideration of specific environmental influences and the biology and behavior of the particular pests, to other urban locations. It is most useful as one example of integrated pest management.

259.

Barnes, A.M. "Problems of rodent control in rural tropical areas." Bulletin of the World Health Organization, Vol. #52 (4): page 669 (1975).

Rodent control strategies, techniques and research needs in rural tropical environments are reviewed and discussed with special reference to Mastomys natalensis, the possible reservoir of lassa fever in West Africa. In rural tropical areas, native semi-domestic species as well as domestic species, serve as disease reservoirs for humans. The proposed method for rodent control involves an integrated research and control program with public education, personnel training and environmental management as well as rodenticidal measures. This paper provides useful strategies for rodent control in rural tropical areas.

260.

Brown, A.W.A. "Insecticide resistance and the future control of insects." Canadian Medical Association Journal, Vol. #100 (4): pages 216-221 (1969).

Insecticide resistance is stated to have developed in 225 species of insects, mites and ticks, 97 of which attack man and animals. The most important are cyclodiene-resistance, DDT-resistance, and organophosphorus-resistance. Resistance is due to single gene alleles, and the resistance mechanism developed is usually detoxification. Insects that have become resistant to DDT and cyclodiene insecticides are usually combated with organophosphorus compounds. Other control methods include the introduction into a population of males sterilized by irradiation or sterilized by chemosterilants. The author states that the future of insect control will increasingly rely on genetic control as well as utilization of the safer, less persistent insecticides.

261.

Brown, A.W.A. "Pest resistance to pesticides." In: (ed) White-Stevens, Robert, Pesticides in the Environment, pages 457-552, New York: Marcel Dekker, Inc., 1971.

The nature and distribution of pest resistance is discussed with examples in flies, mosquitoes, mites, agricultural insects, parasites on humans and animals, and stored products insects. Physiological mechanisms of resistance for such compounds as DDT, Prolan, cyclodienes, BHC, organophosphates, carbonates, pyrethroids, cyanides, and arsenicals are described. The genetics of resistance is discussed for the above groups of compounds. Elements for understanding the course of resistance are presented and countermeasures for resistance are provided.

262.

Darsie, R.F., Johnson, D.R., Mulhern, T.D., and Pratt, H.D. "Mosquito Abatement for Pest Control Specialists," compiled by Pest Control Magazine.

This pamphlet describes the life cycle of the three genera of mosquitoes of major concern in the United States with information on identification of species. It then describes methods of abatement within the sub-categories of physical control, biological control, and chemical control with specific methodologies and equipment. The utility of this pamphlet for developint nations will depend on the particular species to be controlled and other indigenous environmental factors. It discusses the recent technologies in this field and their relative costs in terms of equipment, manpower, and facilities.

263.

Davies, J.E., Barquet, A., Morgade, C., and Raffonelli, A. "Epidemiologic studies of DDT and dieldrin residues and their relationship to human carcinogenesis." In: Recent Advances in Assessment of the Health Effects of Environmental Pollution, International Symposium. Paris, France: World Health Organization, 1974.

In contrast to dieldrin residues serologic and adipose surveys of the human DDT residue in the population of South Florida exhibited significant demographic characteristics in both tissues. Total DDT residues were higher in blacks than whites, were age and social class dependent; higher residues being found in the less affluent in both races. Similarly, geographic distribution differences have been identified. These demographic and geographic distribution frequencies emphasize the significant contribution of non-dietary sources of DDT in incidental DDT pollution and the identification of clustering within homes and environmental studies in Bahamian island population implicated household dust as a major contributant to this type of pollution in tropical areas. When adipose surveys were stratified for these differences no significant differences in Total DDT adipose residue were observed in autopsy and biopsy comparisons from 122 cancer cases when compared with race, sex and social economically matched controls. Similarly, in separate comparisons of these residues in 24 lung cancers, 14 gastrointestinal cancers, 29 breast cancers and 15 generalized metastatic carcinomas, no significant differences were observed. The complexities of case control residue studies are described.

264.

Davies, J., et.al. "The role of house dust in human DDT pollution." American Journal of Public Health, Vol. #65: pages 53-57 (1975)

Studies were undertaken on a small Caribbean island (population 1,500) unsuitable for agricultural or horticultural development and which had never been sprayed aerially with DDT. The inhabitants were engaged in fishing and tourism. DDT residues in foods consumed by the islanders, in air and in water, were negligible. The results of a questionnaire indicated the widespread use of pesticides including a 5% proprietory solution of DDT for domestic fly and cockroach control. Paired samples showed much higher concentrations of organochlorine residues in interior house dusts than in exterior soils. The average serum DDT residues for 148 islanders were 27 ppb (males) and 36 ppb (females); for DDE 81 and 61 ppb; for total DDT 117 and 106 ppb; and for dieldrin 1.3 and 1.1 ppb, respectively. These levels were higher than in Dade County on the mainland where DDT was no longer available for domestic pest control.

265.

Davis, Joseph H., Davies, John E., and Fisk, Arthur J. "Occurrence, diagnosis, and treatment of organophosphate pesticide poisoning in man." Annals of the New York Academy of Sciences, Vol. #160 (1): pages 383-392 (1969).

This paper presents a synthesis of a multidisciplined approach to poisoning in human beings from organophosphorus pesticides. Aspects of epidemiology, clinical diagnostics, laboratory data, and therapeutics are involved. The concepts provided reflect the observations of the investigators within a specific community.

266.

Dempster, J.P. "Effects of organochlorine insecticides on animal populations." In: (ed) Moriarty, F. Organochlorine Insecticides: Persistent Organic Pollutants, New York: Academic Press, Inc., 1975.

The first topic discussed is the reductions in populations due to direct toxic effects of pesticides, due to secondary poisoning, or due to the elimination of prey organisms. Increases in pest populations are discussed with respect to pest populations, non-target species, and replacement of one species by another. Other effects discussed include sublethal and genetic effects.

267.

Durham, William F. "Body burden of pesticides in man." Annals of the New York Academy of Sciences, Vol. #160 (1): pages 183-195 (1969).

Storage of pesticides, particularly the chlorinated hydrocarbons, is discussed in this paper. Analytical methods for the determination of pesticide levels in various systems are discussed. The literature related to levels of chlorinated hydrocarbons in living tissue is reviewed and reported associations between stored levels and health effects are discussed.

268.

Edwards, C.A. Persistent Pesticides in the Environment, Cleveland, Ohio, CRC Press, 1973.

The persistent pesticides, especially the organochlorine insecticides, have conferred tremendous benefits on mankind by controlling the arthropod vectors of serious human disease and by greatly increasing yields of many crops. In recent years there have been many reports of residues of persistent pesticides in air, rain water, dust, rivers and the sea, and in the bodies of aquatic and terrestrial invertebrates, fish, birds, mammals, and man. The largest amounts of residues occur in the tissues of animals near the top of food chains, particularly predators and carnivores, and in man. The importance of these persistent residues in the environment has not yet been fully assessed. The occurrence and persistence of pesticides is elucidated in the physical environment and the biota. Persistent pesticides other than organochlorines include inorganic pesticides, herbicides, fungicides, other insecticides, and PCBs. Persistent pesticides in the environment can be minimized by the use of alternative pesticides, better use of pesticides, removal of pesticides, and use of substitutes for pesticides. Government control of pesticide use is discussed and the dynamics of pesticides in the environment is presented. Comparative data on the amounts of residues in the environment are presented, showing where the largest residues are and how they are concentrated from the physical environment into plants and animals and from lower organisms into the high trophic levels of food chains.

269.

Ehrich, M. Ouellette, R. and Cohen, S.D. "Toxicologic interactions involving dichlorvos (DDVP)." Society of Toxicology: Fifteenth annual meeting: Abstracts, pages 25, 27, London: Academic Press, 1976.

Male mice were given dieldrin (16 mg/kg,po) and sacrificed 4 d later. Liver binding in vivo of malaoxon (MX) and paraoxon (PX) were increased about 50%. DDVP binding was unaffected. DDT (50 mg/kg, i.p.) given 4, 2.3 and 2.5 d prior to sacrifice increased by 30% the binding of DDVP, but not that of MX or PX. In similarly treated mice, neither DDT nor dieldrin affected DDVP's in vivo anticholinesterase (antiCHE) action, but pentobarbital sleep time was decreased. DDVP (30 mg/kg, i.p.) and methyliodide (CH_3I) (135 mg/kg, po) reduced liver glutathione (GSH) concentrations by 20% with ½ hr. and 53% within 1 hr., respectively. However, CH_3I given 1 hr. prior to DDVP did not alter DDVP's antiCHE action, suggesting that in mice most DDVP detoxification is not GSH-dependent. Combined inhibition of binding and GSH-dependent detoxification by triorthotolyl phosphate (125 mg/kg, i.p.) and CH_3I (135 mg/kg, po), given 18 hr. and 1 hr., respectively, prior to DDVP did not affect DDVP's antiCHE action. Hepatic A-esterase activity was 1,160 nmole of DDVP metabolized/g/min and may be sufficient to account for DDVP detoxification when both the binding and GSH pathways are blocked. DDVP (25 mg/kg,i.p.) potentiated the antiCHE action of MX (10 mg/kg, i.p.) given ½ hr. after pretreatment. This was associated with a 68% reduction in hepatic MX binding after DDVP. DDVP toxicity was not altered by the other toxicants but it potentiated MX toxicity.

270.

Farvar, M.T., Winter, M. and Thomas, M.L. "Pesticides in developing countries--significance of chlorinated hydrocarbon residues in human milk from Central America." International Conference on Environmental Sensing and Assessment: Vol. #1, New York: Institute of Electrical and Electronics Engineers, 1976.

Organochlorine residues in human milk from Livington, LaBomba, Asuncion Mita, Cerro Colorado, El Rosario, Guatemala City, and Nabaj, Guatemala were analyzed by gas chromatography. Maximum, minimum, and average values of DDT in each community are compared with the WHO-FAO acceptable daily intake of 0.005 mg/kg body weight. The main cause of unusually high residues of DDT in human milk is indoor spraying by malaria eradication teams. When indoor spraying of DDT is stopped, the residue levels in human milk drop rapidly in a matter of a few years.

271.

Fishbein, L. "Teratogenic, mutagenic, and carcinogenic effects of insecticides." In" Recent Advances in Assessment of the Health Effects of Environmental Pollution, International Symposium. Paris, France: World Health Organization, 1974.

There is increasing concern over the possible toxicological hazards posed by a spectrum of environmental chemicals including industrial pollutants, pesticides, food additives, and drugs, either considered singly as a class or specific agent or in combination. A number of insecticides, based on aspects of their ubiquity, persistence, presence, and/or concentration in the food chain as well as their biological and toxicological properties, constitute a major source of potential environmental hazard to mammal species including man. However, there exists considerable disagreement concerning the scientific assessment of effects (notably teratogenic, mutagenic and carcinogenic) of these agents, primarily because of the variety of testing procedures employed within the three major areas of toxicity, hence complicating comparisons within any one area; complexity of unambiguous recognition and interpretation of the toxic event and finally the extrapolation and relevance of experimental laboratory findings to man. To permit a more orderly assessment of the above effects the possible interrelationships between teratogenicity, mutagenicity, and carcinogenicity will be cited as well as the most salient features of the respective testing procedures employed with concomitant clarification of their principles, problems, and interpretations.

272.

Hayes Jr., Wayland J. "Pesticides and human toxicity." Annals of the New York Academy of Sciences, Vol. #160 (1): pages 40-54 (1969).

This paper outlines the epidemiology of poisoning by pesticides and summarizes the criteria of safety. Conclusions are drawn, based on the epidemiological evidence discussed, regarding safe handling and exposure limits.

273.

Hayes Jr., Wayland J. Toxicology of Pesticides, Baltimore, Md.: The Williams and Wilkins Co., 1975.

This text provides a comprehensive discussion of the toxicology of pesticides. Types, usages, and benefits of pesticides are detailed. General principles of toxicity such as dosage are presented. Extensive discussions are provided for the general principles of metabolism, the nature of injuries, studies of pesticide exposures in humans, recognized and possible exposures to and effects of pesticides, diagnosis and treatment of poisoning, prevention of injury by pesticides, effects on domestic animals, and effects on wildlife. This text may be useful in understanding the toxicology of pesticides and it also provides useful methods for prevention of injury.

274.

Holden, A.V. "Monitoring persistent organic pollutants." In: (ed) Moriarty, F. Organochlorine Insecticides: Persistent Organic Pollutants, New York: Academic Press, Inc., 1975.

This paper discussed numerous factors involved in monitoring organic pollutants. Purposes for monitoring and types of pollutants that persist are presented. Selection of samples from soil and sediments, water, air and precipitation, vegetation, invertebrates, and vertebrates is discussed. An organization for monitoring programs is provided.

275.

Jager, K.W. Aldrin, Dieldrin, Endrin and Telogrin. Amsterdam: Elsevier Publishing Co., 1970.

A brief introduction to the various health aspects of pesticide use is provided, followed by a discussion of the relevant toxicology and of certain general principles of toxicology. A study is described in which people were monitored by determining insecticide levels in their blood chromatographically. A review of animal and human toxicological data from the literature is provided.

276.

Jones, B.R., The prevention of blindness from trachoma. Transactions of the Ophthalmological Societies of the United Kingdom, Vol. #95: pages 16-33 (1975).

This paper discusses the problem of trachoma—its cause and effect and the fact that it is one of the few blinding diseases that can be prevented by sanitary measures primarily. It is a major problem in rural underdeveloped areas, especially in children and may be transmitted from eye-to-eye by direct contact between children, spread by fingers, use of face-wiping cloths, and transmitted by flies. The disease organism, Chlamydia, has been found inside the eye-seeking flies commonly found around nasal and ocular secretions. Proper sanitary measures and fly eradication are suggested as means of prevention. This provides useful information on the transmission of trachoma.

277.

Klemmer, Howard W. "Human health and pesticides - community pesticides studies." Residue Review, Vol. #41, pages 55-63 (1972).

Five years of research by the Hawaii Project are briefly reviewed. A high rate of pesticide use is noted for both rural and urban areas of the state. In a random survey of the city and county of Honolulu, usage of pesticides was found to correlate positively with sinus trouble, asthma, and bronchitis.

Occupational usage of pesticides has been extensively studied. In one study, different types and degrees of exposure have been correlated with different parameters of health in more than 300 volunteer participants. Levels of common organochlorine residues and of pentachlorophenol in the serum of these individuals correlated with occupational exposure class, with enzyme and protein components of the serum, and with other clinical parameters. This paper discusses possible health correlations with pesticide exposure.

278.

Kraybill, H.F. Pesticide toxicity and potential for cancer: a proper perspective. Pest Control, Vol. #43 (12): page 9 (1975).

This paper discusses pesticide toxicity, the potential for cancer and the significance of pesticide toxicity. Of the pesticides tested, insecticides show the largest percentage distribution for carcinogenic activity with the organochlorine compounds usually showing the most carcinogenic activity. The principles used in the assessment of risk are the body retention time and body burden, threshold levels, safety margin for susceptibles in a population, time for tumor formation, metabolic overloading, and epidemiological verification of experimental studies.

279.

Kraybill, Herman F. (ed) "Biological effects of pesticides in mammalian systems." Annals of the New York Academy of Sciences, Vol. #160 (1): pages 1-422 (1969).

This document provides a collection of papers presented at a conference in Biological Effects of Pesticides in Mammalian Systems. Topics include: general aspects of pesticide use, pesticide residue analysis, metabolism of pesticides, occurrence and distribution of pesticide residues, biochemical effects, biochemical and pathologic effects, toxicology and physiology, and perspective in biological and clinical research on pesticides. This publication includes the results of scientific and technologic research and provides extensive information on biological effects of pesticides. However, it may not be useful to the developing nations in providing practical, technical or methodological approaches to solving problems relating to pesticides.

280.

Kurtz, P.J. "Behavioral toxicity of pesticides: Physiological and behavioral effects of a carbamate compound." Society of Toxicoloty: Fifteenth annual meeting: Abstracts, page 27, London: Academic Press, 1976.

Decreases in rat plasma, erythrocyte, and brain cholinesterase activities after i.p. injection of 1-5 mg/kg of 4-benzothienyl-N-methyl carbamate (Mobam) were compared with decrements in spontaneous motor activity and changes in the performance of a rapidly acquired conditioned avoidance response produced by this compound. Effects were observed with all 5 measures at dosages producing no obvious clinical signs. A dosage of 2 mg/kg depressed plasma and erythrocyte cholinesterase activity and decreased motor activity 15 min. after injection, but only higher dosages (3-5 mg/kg) depressed brain cholinesterase activity and avoidance performance. A possible explanation is that the depression in spontaneous motor activity with the lower dosages is related to peripheral nervous system cholinesterase inhibition while the effects of higher dosages on avoidance performance are related to depressed brain cholinesterase activity.

281.

Loomis, E.C., and Boardman, R.M. (Eds) "Research on Mosquitoes - 1975; a report by the agricultural station and U.S. Schools of Public Health." Division of Agricultural Sciences, University of California, 1977.

This publication includes a description of numerous studies in mosquito control. The methods practiced are either biologic, genetic or chemical in nature. The biologic control methods presented include the introduction of mosquito fish, parasitic roundworms and flatworms, and fungi into breeding waters to feed on mosquito larvae. Chemical control measures include the use of synthetic pyrethrum compounds, insect growth regulators and other novel insecticides. The economics of mosquito control are discussed as well as public health aspects of mosquito research. This publication reflects research on certain species of mosquito in California. The techniques may or may not be applicable to other parts of the world.

282.

Matossian, R.M. and Ibrahim, J. "Rats, flies and mosquitoes of Lebanon: Pests, reservoirs and vectors of disease." J. Med. Liban, Vol. #27 (4): pages 375-381 (1974).

This review discusses the roles of rats, flies, mosquitoes and fleas in the transmission of disease. The role of vectors in the transmission of arboviruses is described. Effects of bites and stings are discussed. The relationship of sanitation to disease prevention is discussed. Animal reservoirs, such as cattle, dogs and swine are mentioned and certain specific diseases are discussed: dengue, bacillary dysentery, leptospirosis, malaria, plague, rabies, salmonella infections, typhus and trichinosis.

283.

Metcalf, Robert L. "The chemistry and biology of pesticides." In: (ed) White-Stevens, Robert, Pesticides in the Environment, pages 1-144, New York: Marcel Dekker, Inc., 1971.

This paper provides a detailed discussion of the major types of pesticides: fungicides, herbicides, insecticides, molluscacides, nematocides, and rodenticides. A total of more than 600 chemical compounds are described with major emphasis placed on basic chemistry of the compounds, the relationship of structure to pesticidal activity, the physiological and biochemical mechanisms of action, the general biological activity of the compounds, and their mammalian toxicology. This chapter may be useful as a condensed handbook of the properties and uses of pesticides.

284.

Moore, N.W. "The ecological approach to pesticides and its relevance to human disease." In: (ed) Howe, G. Melvyn and Loraine, John A. Environmental Medicine, London: William Heinemann, Medical Books Limited, pages 110-118 (1973)

This paper describes some recent studies on the effects of pesticides on wild organisms and indicates their possible relevance to medicine. Studies of acute and subacute effects are discussed. The author stresses the need to account for ecological principles in studying pesticides and describes a complex interrelationship between a given pesticide, a population of organisms, and many other factors.

285.

Moriarty, F. (ed) Organochlorine Insecticides: Persistent Organic Pollutants. London: Academic Press, Inc., 1975.

This text discusses the organochlorine insecticides and proposes that through knowledge of these compounds, understanding may be gained of other pollutants in the environment. The first three chapters focus on the amounts of residues present: how to monitor them, the relationship between exposure and size of residues found in animals, and why different animals may acquire different residues from similar exposures. The next two chapters discuss the effects of residues on animals: single individuals, and populations. The final chapter discusses some of the economic and legal constraints that exist, or could be imposed, for the control of pesticide use.

286.

Nisbet, I.C.T. "Global pollutants." Technology Review, Vol. #77 (3): pages 6-7 (1975).

Two environmental surprises of the late 1950's and early 1960's were the discovery of DDT and other chlorinated hydrocarbons in remote parts of the world, and the strong tendency of these substances to bioaccumulate. Widespread dissemination of these relatively nonsoluble and nonvolatile substances is now attributed to unintentional but nevertheless large-scale direct dispersal into the air, covolatilization from porous soils with evaporating rain water, and appreciable direct volatilization over long periods of time. Water transport is relatively unimportant for dissemination; fish kills of dramatic magnitude are usually traceable to direct application, or deliberate discharge into, natural waterways. Transfer into water by being bound to eroding soil particles can, however, be important for individual pesticides, such as aldrin and heptachlor. The deposition of such contaminated sediments can lead to very high local accumulations of residues; such pollutant traps include reservoirs in the American Midwest, the lower Great Lakes, the Baltic Sea, and semi-enclosed marine basins such as the Gulf of St. Lawrence, San Francisco Bay, the Irish Sea, and the Japanese Inland Sea. The formulation of models for global transport of persistent chlorinated hydrocarbons is now possible. The major sinks are biodegradation in soils and sediments, photochemical degradation, sequestration in shallow-water sediments, and transfer to the deep oceans. Some quantitative development of these models have given plausible results, but they are still largely empirical.

287.

Oser, Bernard L. "Toxicology of pesticides to establish proof of safety." In: (ed) White-Stevens, Robert, Pesticides in the Environment, New York: Marcell Dekker, Inc., pages 411-456, 1971.

The typical means of testing potential hazards of pesticides is by toxicological tests with laboratory animals from which safety levels for human exposure are established. The assessment of occupational hazards is discussed. The tests involved include dermal toxicity, mucus membrane and eye toxicity, inhalation toxicity, oral toxicity, reproduction and teratology, and carcinogenesis. The inherent limitations in the use of animal toxicity data for human safety standards are discussed. The problem of assessing the "no-effect" level is presented and the issues of safety factors and tolerance levels. A brief discussion of toxicological tests of pesticides on human beings is provided. Estimations of hazard to fish and wildlife are discussed.

288.

Pollack, Bernard L., Ebenstein, Howard and Ernsberger, Mary. "Pesticide Safety." Peace Corps Information Collection and Exchange, May, 1977.

This publication discusses the toxicities of some common pesticides including fungicides, herbicides, insecticides and nematocides. These substances are classified by degree of danger based on oral and dermal LD_{50} data from white male rates. Safety guidelines are provided for storage and application of pesticides. Symptoms of pesticide poisoning are described briefly and first aid measures are described. This is a useful pamphlet to distribute to the lay person and is written at a simple level.

289.

Seiber, J.N. and Woodrow, J.E. "The determination of pesticide residues in air." International Conference on Environmental Sensing and Assessment: Vol. #1. New York: Institute of Electrical and Electronics Engineers, 1976.

The methodology and relative merits of various procedures available for determination of pesticides in air are discussed, with emphasis on sampling methods for monitoring ambient concentrations. Static sampling methods, in which no mechanical concentration of the air precedes determination, and dynamic methods, in which a collection device is used, are examined.

290.

Shimkin, Michael B. "Summary of the Conference on Biological Effects of Pesticides in Mammalian Systems." Annals of the New York Academy of Sciences, Vol. #160 (1): pages 418-422 (1969).

This paper presents a summary of the concepts presented in the conference and proposes certain conclusions and alternative solutions to the pesticide and health issue. The author expresses his personal viewpoints on the nature of the problem and proposes areas of research which he considers most critical. Suggestions are posed for societal actions for the control of the pesticide hazard.

291.

Sholdt, L.L., Brothaus, R.H., Schreck, C.E., and Gouk, H.K. Field studies using repellant-treated wide-mesh net jackets against Glossina morsitans in Ethiopia. East African Medical Journal, Vol. #52 (5): page 277 (1975).

Compared the effects of five insect repellants on jackets in terms of how well they protected against the tsetse fly, vector of trypanosomiasis, for how long, and in terms of any apparent effects on humans.

292.

Simmon, V.F., Poole, D.C. and Newell, G.W. "In vitro mutagenic studies of twenty pesticides." Society of Toxicology: Fifteenth annual meeting: Abstracts, page 33, London: Academic Press, 1976.

The following pesticides were evaluated for their mutagenic potency in 4 microbial assay systems: folpet, captan, methyl parathion, parathion, malathion, bromacil, guthion, azodrin, pentachloronitrobenzene, phorate, dinoseb, dursban, monuron, monosodium methanearsonate, disodium methane arsonate, cacodylic acid, fenthion, trifluralin, methonyl, and simazine. The assay systems employed include the histidine reverse mutation system in 5 strains of Salmonella typhimurium, an assay of mitotic recombination in a diploid strain og Saccharomyces cerevisiae, and relative toxicity assays in Escherichia coli and Bacillus subtilus. A mammalian metabolic activation system using the liver of rats which had been treated with Aroclor 1254 was used in all of the assays except the B. subtilis assay. Folpet, captan, and bromacil were mutagenic and all of the assays. Azodrin, cacodylic acid and guthion increased mitotic recombination in S. cerevisiae. Dursban and dinoseb were more toxic in repair deficient strains of B. subtilis and E. coli than in repair proficient strains of these organisms.

293.

Steinbrink, H. Laboratory experiments with a view of combating cockroaches with the aid of boron preparations. Z Ges Hyg 22 (6): page 419 (1976).

Borax and boric acid were tested for effectiveness in killing Blatella germanica L and Blatella orientalis L and found to be effective. These substances are also found to be of low toxicity to warm blooded animals. Needs further testing before human use."

294.

Tschirley, F.H. Pesticides in relation to environmental quality. In: Environmental Quality and Food Supply, Ed. P.L. White, Futura Publishing Co., Inc., 1974.

This is a general discussion of some environmental concerns with pesticide use and other alternative means of pest control. The pests of concern are primarily agricultural and some of the techniques described may be less applicable to disease vectors. Primary concerns of pesticide use are toxicity to animals and humans, and persistence in the environment. This paper provides a basis for understanding the environmental ramifications of pesticide use.

295.

Vandekar, M. "Effect of pesticides on physical health." International Conference on Environmental Health, Pages 97-103, Primosten, Yugoslavia, 1973.

The effects of pesticides on physical health are discussed, focusing primarily on human data. The primary sources of data are discussed; consumption of food containing residues, occupational exposures, and accidental poisoning.

296.

Victor, P.A. and Mansell, W.M. "Persistent pesticides: An economic and legal analysis." In (ed) Moriarty, F. Organochlorine Insecticides: Persistent Organic Pollutants, pages 249-296, New York: Academic Press, Inc., 1973.

This paper provides an economic analysis of the persistent pesticide issue. Topics discussed include: economic and political context of agriculture in mixed economies, a micro-economic analysis of the farmer's decision to use a persistent pesticide, and the decision-making framework. Legal aspects of persistent pesticides include various common law, statutory law and international aspects of pesticide regulations.

297.

Application and Dispersal of Pesticides: Eighteenth Report of the WHO Expert Committee on Insecticides, Geneva, 1971. WHO Technical Report Series No. 465.

This report describes recent research on hand-operated compression sprayers--the mainstay of most insect control operations. The problem of nozzle tip erosion is discussed. The effectiveness of insecticides due to optimum particle and droplet size is discussed and methods of determining droplet size of aerosols and sprays are described. Other equipment, both manual and power-operated, are considered. Spraying from ground level versus from the air are discussed. This report may provide useful information on optimization of the safety and effectiveness of pesticides.

298.

"Toxic hazards of pesticides to man." WHO Technical Report Series No. 227. Geneva: WHO, 1962.

This report discusses the hazards involved in pesticide use. The need for alternatives are discussed. Hazardous situations such as accidental exposure, and protection against exposure are addressed. Based on the information provided, extensive recommendations are presented for the control of pesticide use and the protection of populations from hazardous exposures.

299.

"Use pesticides correctly, a guide for commercial applicators." U.S. Department of Agriculture, U.S. Environmental Protection Agency.

This pamphlet includes a description of common pests, including those carrying

142

human diseases, those causing discomfort, agricultural pests, and those causing other types of nuisance. Some basic principles of pest control are presented and pesticides are classified and described. Safety measures in handling pesticides, types of application equipment and laws and regulations are discussed. This pamphlet is written at an elementary level with numerous pictures and diagrams. It may be useful in presenting certain basic concepts of pesticide use to individuals with no previous background.

RADIATION

300.

Brodine, V. "Radioactive contamination." In: (ed) Commoner, B., Environmental Issues Series, New York: Harcourt Brace Jovanovich, 1976.

The wide array of hazards generated by the introduction of man-made radioactive agents into the environment, and the gains that can be made by reducing them, are presented. The scope and content of determining these dangers, and the evaluation of their environmental impacts are set forth, and a comparison is made of the dangers involved and the benefits expected. Conservation of electricity and replacement of power generated with nuclear reactors by solar energy are considered as alternatives to the breeder reactor. Radioactivity in the environment and in people, and nuclear tools for medicine, research, and industry are discussed. Conventional military weapons vs. nuclear weapons are compared. Appendixes include units of measurement for radioactive materials and exposure, radiation protection guides for normal peacetime activities and for occupational exposure, and a table of selected radionuclides.

301.

Cardozo, R.L. "The dispersal of radioactive matter by evaporation." Health Physics, Vol. #25 (6): pages 593-598 (1973)

The evaporation velocity is calculated for radioactive substances that do not have a negligible vapor pressure under normal conditions of temperature and pressure. The maximum permissible concentration in air is readily attained for many compounds. A classification according to the degree of danger is given based on an evaporation time which can be calculated for any compound under given conditions.

302

Cohen, B.L. "Dose consequences from airborne radioisotopes." Controlling Airborne Effluents from Fuel Cycle Plants. Hinsdale, Ill.: American Nuclear Society, 1976.

Models are developed which estimate doses administered by internal deposition and external radiation. The dose to the respiratory system depends on the product of the amount of radioactivity deposited and the time it remains there. The amount of radioactivity which reaches other organs and its time of residence there is combined to give the radiation dose to various body organs per uCi inhaled of any given radionuclide. The early effects of very large radiation doses, i.e., hundred of rem or more, on the human bone marrow, lungs, gastrointestinal (G-I) tract, and thyroid are discussed. The doses which cause sterility, cataracts, prodromal vomiting, and undesirable prenatal effects are also given. The primary health effect to exposed individuals occurring years after exposure is cancer, and the BEIR report risk model is used to predict the risk of leukemia and lung, G-I tract, breast, and bone cancer. The BEIR model is also used to predict the genetic effects of radiation to the gonads.

303.

Davis, J.C. "Coping with nuclear wastes." Chemical Engineering, Vol. #81 (2): pages 82, 84 (1974).

Techniques for reducing vol and for packaging nuclear wastes are described. Information is provided on the accidental spillage of 115,000 gal. of highly radioactive wastes at the Hanford Plant near Richland, Washington, in April, 1973; surveillance and solidification methods; preparation of salt cake, and the use of Radwaste, a process which seeks to utilize radioactive wastes to sterilize sewage sludge.

304.

Dugle, J.R. and Thibault, D.N. "Ecology of the field irradiator-gamma area III. Revisions to botanical methods and vegetation sampling procedures (AECL-4135)." Atomic Energy of Canada, Ltd., 1974.

The botanical field methods to be followed in the Field Irradiator-Gamma area are described, with the principal method involving the use of sampling quadrants. All quadrants, plots, and vegetation of special interest were mapped and marked. The parameters samples, which include species numbers, diversity, and within-species changes, will allow a comparison of pre-and post-irradiation levels. Information is provided on biomass measurements, trees for growth study, leaf canopy, invasion of weedy plants, radiation-altered plants, and radiation disometry. The projects will be carried out in a quarter-section of mixed-boreal forest within the Whiteshell Nuclear Research Establishment's controlled area (Manitoba).

305.

Forester, W.S. "Environmental radiation under attack." Environmental Science and Technology, Vol. #7 (13): pages 1104-1105 (1973).

Environmental radiation has 2 major sources, natural background and medical usage. Radiation received during jet plane travel, from nuclear weapons fall-out, and from nuclear power plant emissions, while not major sources, must be considered important areas of radiation exposure. It has been estimated that by the year 2000, 314,000 human deaths will be attributable to radiation-induced mutations, which can cause human developmental variations, stillborn infants, and other problems. There are also nonionizing sources of radiation including microwave ovens and heating equipment. These sources employ UV, IR coherent electromagnetic radiation (laser), and radio frequency radiation. Risk-benefit and cost-effectiveness assessments have been suggested to logically decide the worth of any given effort to reduce the risk of environmental radiation.

306.

Gera, F. "The classification of radioactive wastes." Health Physics, Vol. #27 (1): pages 113-121 (1974).

Various proposals of classification of radioactive wastes are reviewed. The need for standardized waste categories could be satisfied by simply defining the meaning of the terms in common use. The classification of wastes would be into 2 groups: the 1st formed by wastes requiring relatively short-term containment and acceptable for disposal by shallow burial; the 2nd would contain wastes requiring long-term containment and destined for disposal in deep geologic formations.

307.

Gibson, J.A.B. and Ahmed, J.U. "Measurement of short-range radiations." Technical Report Series 150, International Atomic Energy Agency, 1974.

The measurement of low-energy X-rays, low-energy particles, and all particles is covered. A small part of the discussion is devoted to the measurement of ultrasoft radiations in the microwave region of the spectrum. Information includes sources of radiation and biological considerations, methods of measurement and detection, choice of instruments, calibration of instruments, and calculation of the dose from α and β radiation at various depths in tissue. Specific topics include sources of short-wave radiation, biological and related parameters, ionization chamber instruments, gas proportional detectors, Geiger-Muller counters, the scintillation detector, liquid scintillation counting, semiconductor nuclear radiation detectros, solid state dosimetry, and monitoring of external sources of various types of radioactivity.

308.

Girardi, F. and Bertozzi, G. "Radioactive waste: Present problems." Nuclear Science Abstracts, Vol. #30 (9): pag 2495 (1974). Also in Euro-Spectra, Vol. #13 (1): pages 23-29 (1974).

309.

Hurst, G.S. , Garret, W.R. and Payne, M.G. "Rationale for radiation protection." Health Physics, Vol. #26 (4): pages 313-318 (1974).

Suggestions are made for a more quantitative rationale for radiation protection. An approach is discussed in which external fields, or the response of suitable detectors exposed to the fields, are transformed into the time-dependent probabilities for specific biological effects in a given species. Detector and computer technologies are emerging which make such a system possible. Suggestions are offered for biological experiments which will maximize the usefulness of radiation effects data in implementing the subject rationale and in understanding biological effects.

310.

Kahn, B. "Background measurements in monitoring radioactive effluent." *Controlling Airborne Effluents from Fuel Cycle Plants*. Hinsdale, Ill.: American Nuclear Society, 1976.

The radiation background at nuclear facilities is discussed with regard to the measurement of airborne effluent in the environment. The effluent can be detected by measuring the increase in the external radiation dose rate or by collecting and analyzing airborne radionuclides. The contribution to ambient radiation and radionuclide levels by cosmic rays, cosmogenic radionuclides, terrestrial radionuclides in the ground and air, and human activities are indicated. Typical radiation dose rates in air and concentration ranges of the more important terrestrial and airborne radionuclides are listed. Dose rates of 0.1-10 mrad/yr from photon-emitting airborne effluent can be measured, in the order of increasing sensitivity, with passive detectors such as thermoluminescent dosimeters, sensitive continuously recording detectors such as pressurized ionization chambers, and scintillation detectors with spectrometers. Procedures are also available for collecting and measuring airborne radioactive particles and gases in effluent at concentrations corresponding to these low annual doses.

311.

Landau, E. "Health effect of low-dose radiation: Problems of assessment." *International Journal of Environmental Studies*, Vol. #6 (1): pages 51-57 (1974).

No successful systematic representation of the risks associated with exposure to ionizing radiation at low doses currently exists. Health effects of low-dose radiation as environmental hazards cannot be derived from experimental work alone. The Oxford Survey of Childhood Cancers, the X-ray technologists study by Miller and Jablon, and the pilot study of South Africa Au-u white miners are discussed in the selection of control populations. These sample studies illustrate the difficulties of avoiding faulty selection of controls and faulty analysis.

312.

Malasek, E. and Kulichenko, V.V. "Review of the research and development work and experience in the field of bituminization in the member countries of the Council for Mutual Economic Assistance." In: *Bituminization of Low and Medium Level Radioactive Wastes*. Paris: Organization for Economic Cooperation and Development, 1976.

The effect on softening point, penetration, and critical temperatures of incorporation of Na, Ca, Fe, Al, and Mn salts into bitumen was investigated. Gas release (H_2, methane, ethane, and ethylene, and carbon dioxide) from pure asphalt and asphalt-sodium nitrate mix was measured following irradiation; concentrations > 10 Ci/ki are potentially explosive. Leaching rates established in the laboratory are of the same order as those observed in experimental storage. Depth of water penetration into bituminous blocks is not directly proportional to time.

313.

Miller, M.W. and Stannard, J.N., eds. Environmental Toxicity of Aquatic Radionuclides: Models and Mechanisms. Ann Arbor, Michigan: Ann Arbor Science Publishers, 1976.

Papers are presented on the impact of radionuclides on the environment. Broad topics considered include the biogeochemistry of transuranic radionuclides, monitoring and evaluation of measurements and their applicability to model making, and the interaction of radionuclides and such environmental components as sediments and organisms.

314.

Miller, R.W. Late radiation effects; Status and needs of epidemiologic research. Environmental Research, Vol. #8 (2): pages 221-233 (1974).

Epidemiologic studies of radiation effects in man are reviewed, based on exposure to the atomic bomb, radiotherapy, diagnostic radiations, and occupational or accidental exposures. Areas studied include genetic effects, fertility, immunology, cancer, congenital malformations, growth and development, aging, cataracts, psychiatric effects, interactions with drugs or viruses, host susceptibility, and radiation factors. Cancer areas discussed include leukemia, thyroid, lung, breast, bone, and liver cancers; lymphoma; salivary gland tumors; brain tumors; nonleukemia cancers; intrauterine exposures; and pre-conception irradiation and childhood cancers.

315.

Rasmussen, N. "Reactor safety: Real Probabilities." Combustion, Vol. #45 (12): pages 8-12 (1974).

Progress made in the last year in the reactor safety areas of steam line break, blowdown and boiling water reactors, fuel densification, emergency core cooling, and anticipated transients without scram, is reviewed. Future problems with pressure vessel failure, overall operating reliability of nuclear plants, diversion of nuclear materials, sabotage, and the toxicity of Pu are discussed. The AEC has openly considered the probability of accidents and has been reorganized with particular regard to safety. A chronology of the 20-year history of the nuclear industry is appended.

316.

Rumsey, R.D.E. "Radiation and Health Hazards." In: (eds) Howe and Loraine, Environmental Medicine, 1973.

This chapter provides a fairly detailed description of health effects of radiation. It includes a discussion of the nature and measurement of radioactivity;

a review of radiobiology; a presentation of sources of environmental radiation and the health effects of radiation. This selection provides a useful review of radiation and the effects of radioactivity. It includes several tables of radiation content, sources of radiation and dosages that are helpful. Also included are commentary and tables from reports of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) from 1958, 1964, 1966 and 1969.

317.

Sagan, L.A. Human and Ecologic Effects of Nuclear Power Plants. Springfield, Ill.: Charles C. Thomas, 1974.

An exposition is presented of the human and ecological effects of nuclear power plants, with emphasis on sources and quantities of radioactivity that enter the environment. Subject areas include the generation and management of radioactivity and the ecological effects of nuclear power generation. Specific topics cover reactor design, standards for radioactive emissions, siting criteria, waste control, accidental releases, shipment of radioactive materials, fuel reprocessing, high level waste, breeder reactors, effects of radioactive emissions from nuclear power plants, effects of thermal discharges, human radiation exposure, genetic damage, and long-lived isotopes.

318.

Sill, C.W. and Hindman, F.D. "Preparation and testing of standard soils containing known quantities of radionuclides." Analytical Chemistry, Vol. #46 (1): pages 113-118 (1974).

A procedure for preparation of standard soils containing a known quantity of any radionuclide is described. Four separate standards have been prepared from 3 different soils using 239 Pu to demonstrate the reproducibility and reliability of the procedure. Analyses using 236 Pu tracer show that the standards contain the exact concentration calculated, that they are not detectably inhomogeneous on samples as small as 1 g, and that homogeneous standards of lower concentrations can be prepared exactly by wt dilutions with the unspiked soils. Only 4 of 56 determinations, made on 1- and 10-g aliquots of the 4 individually spiked standards and 2 others made by dilution, showed distinct signs of inhomogeneity with the particular methods of preparation of sample size employed. The reamining 52 measurements agreed with the calculated value within 3 SDs of the determination, and 42 were within 2 SDs. The dramatic effect of heat treatment on the leachability of the Pu was demonstrated. An alternative method for preparation of solid standards for members of the natural U and Th series is suggested.

319.

Upton, A.C. Radiation Injury, Chicago: University of Chicago Press, 1960.

Source referenced in WHO, 1972, Health Hazards of the Human Environment.

320.

Weng, P.S. and Huan, C.Y. "Personnel and environmental thermoluminescent dosimetry for a university reactor located in a semitropical area." Radiation Data and Reports, Vol. #15 (5): pages 247-252, May 1974.

Lithium fluoride (LiF)-Teflon discs were added to film badges for personnel monitoring during a 6-month period. A consistently higher dose was found in the thermoluminescent dosimeter than in the photographic film dosimeter, which might exhibit about 90% fading during the 4-week period in a hot and humid climate. In winter the response from both LiF-Teflon disc and film showed more consistent results due to better climate conditions in Taiwan. The $CaSO_4$ (calcium sulfate): Dy and $CaSO_4$: Tm phosphor powders and LiF: Mg, Ti, enclosed in a knot of bamboo stick, were used for environmental monitoring at a university reactor building. They were unaffected by extremes of humidity and environmental temperatures in area monitoring, either indoors or outdoors.

321.

American Nuclear Society. Controlling Airborne Effluents from Fuel Cycle Plants. Hinsdale, Ill.: 1976.

Papers are presented on various aspects of radioactive effluents from nuclear fuel cycle facilities. Topics include source terms and methods for suppression, collection, and storage of potential airborne effluents; their transport and biological characteristics; their regulation; the public's concern for such effluents; and the application of effluent controls to fuel cycle plants.

322.

"Biology and Health Physics Division progress report January 1 to March 31, 1974." Atomic Energy of Canada, Ltd. Progress Report PR-B-1-1, May 1974.

Work done by the biology, population research, environmental research, and health physics departments of the Chalk River Nuclear Laboratories is reviewed. The basic mechanisms of damage and repair involved in radiation-caused injuries have been studied by the biology branch. The population research group is working on the induction of skin tumors in rats, to test for a possible multiplicative effect of combined treatments with radiation and chemical carcinogens. Studies on nutrient cycling and hold-up in some terrestrial plants in the Perch Lake watershed have been initiated in the area of environmental research. The health physics section has created a model of a new photobadge, which contains personal dosimetry components. It has been fabricated and tested and has proved to be a good indicator of radiation dosage.

323.

International Atomic Energy Agency. "Environmental behavior of radionuclides released in the nuclear industry." Proceedings Series, Vienna, 1973.

Papers and discussions on the environmental aspects of the nuclear industry are presented. Topic areas include the production and release of radionuclides, environmental behavior of radionuclides, behavior of radionuclides in aquatic environments, behavior of radionuclides in terrestrial environments, biological transfer of radionuclides, models for predicting radiation exposure in population groups, estimation of environmental capacity, and environmental programs.

324.

International Commission on Radiological Protection (1966). London: Pergamon Press, ICRP Publication.
International Commission on Radiological Protection (1960). Radiosensitivity and Spatial Distribution of Dose, London: Pergamon Press, ICRP Publication 14.
International Commission on Radiological Protection (1970), Protection Against Ionizing Radiation from External Sources, London: Pergamon Press, ICRP Publication 15.
International Commission on Radiological Protection (1970). Protection of the Patient in X-ray Diagnosis. London: Pergamon Press, ICRP Publication 16.

The ICRP sets standards of radiation safety expressed as maximum permissible doses that are universally accepted. These and other publications of the ICRP are very useful for assessing and setting guidelines for the use of an exposure to radioactivity.

325.

Nuclear Science Abstracts, Vol. #29 (11): page 2796 (1974).

Some 169 environmental information sources listed in 2 compilations were surveyed to ascertain their relevance to radiation and nuclear power, their users, and type of information products. Of the 92 information sources responding to this survey, only 51 were relevant and were included in the report. The significant characteristics of each of the 51 centers are tabulated and the results summarized. Services were available to each of 5 user classifications from over 90% of the centers and the available information types are varied. One-third of the centers charge for some of their services. Many others had the matter under consideration.

OCCUPATIONAL HEALTH

326.

"Radiation hazards in perspective." WHO Technical Report Series No. 248. Geneva: WHO, 1962.

Radiation hazards are discussed in relation to other environmental hazards. The approach to risk is compared for radiological and toxicological hazards. The injuries incurred by radiation and toxic chemicals are contrasted. Carcinogenesis and genetic effects in general are addressed with respect to a variety of potentially causal environmental hazards.

327.

Czapski, J. and Kloetzel, K. "Schistosomiasis mansoni in workers and as an occupational disease." IN: International Congress on Occupational Health, September 22-27, 1969, Tokyo, Japan, pages 273-275, Tokyo, Japan: Industrial Safety Assoication, 1971.

This paper reports that plantation workers in Brazil are exposed to schistosomiasis as an occupational disease. These workers in endemic areas are exposed at work to infected water and soil. It was found that 59% of those workers regularly contacting water in the course of their duties contracted the disease while only 10% of unexposed workers contracted the disease.

328.

Derban, L.K.A., Some environmental health problems associated with industrial development in Ghana. Ciba Foundation Symposium, 32. p. 49-71, 1975.

This paper first describes the basic environmental health problem areas in developing countries as inadequate supply of sufficient drinking water, poor or non-existent waste disposal systems for human excreta and refuse, undernutrition and malnutrition, inadequate housing and abundant disease vectors. However, a growing concern is with the effects of industrialization. Major impact on the human environment is caused by urbanization and migration, industrial pollution of air, water, and soil, the use of pesticides, and river basin development and resettlement. This description of the existent problems in a developing nation, Ghana, is helpful in understanding the priorities established in many developing nations.

329.

El Batawi, M.A. "Epidemiology of intoxication in industry." In: Recent Advances in Assessment of the Health Effects of Environmental Pollution, International Symposium. Paris, France: World Health Organization, 1974.

The value of carrying out longitudinal studies of environmental exposure to different concentration levels of toxic substances in industry and the corresponding biological effects on man is undeniable in establishing criteria that are based on human experience. A survey has been conducted in several countries to find out the extent to which different institutions have carried out such studies. The results show that, although there is a good deal of valuable information obtained from epidemiological studies (a review of which will be presented) of exposure to certain toxic agents such as carbon disulphide, organic solvents, lead and other heavy metals, there is an outstanding need for the development of epidemiological methods in industry and for international collaboration in this field.

330.

Gray, J.H., Murbach, E.W. and Williams, A.K. "Experience and plans for effluent control at LWR fuel reprocessing plants." Controlling Airborne Effluents from Fuel Cycle Plants. Hindale, Ill.: American Nuclear Society, 1976.

The Allied-General Nuclear Services Plant (AGNS) was designed and constructed to achieve the necessary retention factors for the various radionuclides as determined by existing regulations and in accordance with the concept of effluent control at levels as low as reasonably achievable. Presently at AGNS, the reprocessing facility and the uranium hexafluoride (UF_6) conversion facility are complete. Facilities for Pu conversion and waste solidification are planned. The plant's retention system for I consists of 2 mercuric nitrate scrubbers in series with a final backup of silver zeolite beds in parallel. If experience shows that appreciable I is released through the main stack with water vapor, a maco-reticular resin bed can be utilized to remove I from the liquid stream ahead of the vaporizer. Particulate release is controlled by mist eliminators in the evaporators, condensers, scrubbers, and high efficiency particulate air (HEPA) filters. All ventilation systems pass through at least 2 stages of HEPA filtration prior to being discharge redionuclide; and the health effects caused by such releases include radiation-induced somatic effects such as lung, thyroid, or skin cancers and certain serious genetic effects in future generations. The projected numbers of health effects due tc the release of ^3H, ^{85}Kr, ^{129}I, and actinides are presented. Using the value $1,000/man rem, the monetary damage resulting from the release of these radioisotopes is also estimated, and cost-benefit comparisons are made. The results are disturbing and reflect the great need for pollution control in the nuclear fuel cycle.

331.

Jones, L.V. Annals of Occupational Hygiene, Vol. #3, page 358 (1959).

Cited in WHO, 1972, Health Hazards of the Human Environment.

332.

Mayers, May R., Occupational Health, Hazards of the Work Environment, Baltimore, Md.: The Williams and Wilkins Company, 1969.

In this volume, the reader is introduced to many varieties of health hazards characteristically associated with industry and other occupations (agriculture, mining, aviation and work in laboratories), and current modalities of control and prevention. Its distinctive features are its emphasis on environmental physiology in terms of homeostasis, and its concern with the biological uniqueness of the individual. The goal should be maintenance of homeostasis, rather than merely the prevention of clinically recognizable occupational diseases, since the later develop only when the body's defense mechanisms are being overwhelmed. Special emphasis is placed, therefore, upon the vital importance of early detection of histochemical changes and metabolic disturbances, while they are still reversible, in advance of symptoms. Consideration is given to the urgent need for further research, to this end, not alone on laboratory animals, but on workers in the field, under actual working conditions. Occupational disease diagnosis is considered in relation to the medicolegal problems which arise in connection with workmen's compensation.

333.

Mery, J.C. Caractere, effets et evaluations des bruits intermittents dans l' industrie et l'habitat, Centre de Biologie climatique du CNRS, Strasbourg, 1968.

Cited in WHO, 1972, Health Hazards of the Human Environment.

334.

Metz, B. "Ambiances Thermiques." In: (ed) Scherrer, J., Physiologie du Travail (ergonomie), Vol. #II: pages 184-200, Paris, Masson, 1967.

Cited in WHO, 1972, Health Hazards of the Human Environment.

335.

Olishifski, P.E. and McElroy, F.E. Fundamentals of Industrial Hygiene, Chicago: National Safety Council, 1971.

This book provides the basic principles of industrial hygiene and discusses a variety of occupational diseases. The diseases are described with respect to symptoms, lasting effects, and means of contact.

336.

Paretto, L.A. "Study of silicosis in Peruvian mines and permissible dust concentrations." American Industrial Hygiene Association Journal, Vol. #32 (7): pages 463-467 (1971)

This paper discusses a study of cases of occupational silicosis due to exposure to silica dust in mines. Factors affecting the degrees of exposure are described, such as altitude and previous exposure to air pollutants of other types. Maximum permissible exposure levels are proposed.

337.

Phoon, W.O., and Tan, S.B., Environmental and health conditions in small factories in Singapore. Singapore Medical Journal, Vol. #16 (3): pages 177-193 (1975).

This paper describes a survey of 14 industries (83 total factories) with respect to environmental and health factors, Tests were performed for lighting, sound levels, heat stress and dust and exposure to various toxic substances. The factories were all of less than 100 workers and the industries involved included electroplating, chemical manufacture, cement, asbestos, sawmilling, iron foundries, brick manufacture and others. Specific health and safety aspects of the different industries were discussed. Singapore may be used, suggests the author, as a model for what conditions will be like in other Southeast Asian countries as they become more industrialized. Therefore, it may be of value to these other countries to understand the industrial health problems which they may encounter.

338.

Ramalingaswami, V. "Health and industrial growth: the current Indian scene." Ciba Foundation Symposium 32, p. 89-106, 1975.

A description of the current health scene in India showing a trend toward improvement in health along with development. This is attributed to planning over the past 20 years. However, with rapidly increasing population, urbanization, inadequate sanitation, microbial pollution and unprotected water supplies, the health picture is still inadequate. Industrial health is discussed. With large numbers of mine workers there is growing concern with pneumoconiosis and silicosis. Also, water pollution from industrial wastes (acids, alkalis, organic and inorganic chemicals, synthetic detergents, fertilizers, pesticides) is becoming more common and must be diluted by treatment of some sort. Specific air pollution problems in India's large cities are: high concentrations of particulates, carbon monoxide, and sulfur dioxide.

339.

Sofoluwe, George O., "Occupational health and economic development in African countries." Archives of Environmental Health, Vol. 26 (4): p. 165-168, 1973.

Although industrialization has resulted in diseases associated with exposure to various substances, it has also produced enormous benefits. It should be possible in underdeveloped countries to plan a program of technological development that would insure maximum health benefits with minimum injurious consequences. Several examples of first-phase industrialization that would meet these criteria are furnished. Topics discussed include the existing health situation in African countries, the traditional industrialization pattern in an African village, suggested programs geared to solving African health problems, and some examples from developed countries of adapting industrialization to the health of the people.

340.

African labour conditions and health in the Southern Rhodesian mining industry, 1898-1953. Part One: Accommodation. I.R. Phimister, Central African Journal of Medicine, Vol. #21 (10): pages 214-220 (1975).

This article provides a historical perspective on the mining industry in Rhodesia and on how certain environmental health factors were handled specifically, housing and factors relating to it. The author describes overcrowding, flooding, lack of ventilation, no floor covering, often no beds, etc., as normal conditions for the Rhodesian mine workers. These conditions, apparently, persisted throughout the period described (1898-1953) and some of the problems are claimed to persist today.

341.

"Occupational health problems in agriculture." WHO Technical Report Series No. 246. Geneva: WHO, 1962.

Health problems associated with agricultural work are discussed. These include exposure to toxic substances and biologicals such as bacteria, viruses, fungi, rickettsiae, and parasites. Epidemiological data and control measures related to occupational diseases of agricultural workers are discussed and the organization of occupational health in agriculture.

342.

The "Spanish" Influenza pandemic of 1918 and its impact on the Southern Rhodesian mining industry. Central African Journal of Medicine, Vol. #19: pages 143-148 (1973).

This paper describes the impact of the "Spanish" influenza pandemic on mining industry workers and correlates crowded housing conditions with higher numbers of deaths from influenza. The mortality rate from influenza was found to be higher in mine workers than in the general population and higher still in those mine workers living under the most crowded conditions. This paper suggests an association between crowded housing conditions and increased mortality from influenza.

AIR QUALITY

343.

Ayres, S.M., and Buehler, M.E. "The effects of urban air pollution on health." *Clin Parmacol Ther*, Vol. #11: page 337 (1970).

Source not referenced.

344.

Bladen, W.A. and Karan, P.P., "Perception of air pollution in a developing country." *Journal of the Air Pollution Control Association*, Vol. #26(2): page 139 (1976).

This is a study of the perception of air pollution in the Chotanagpur industrial area of India. It was found that people were highly aware of the existence of air pollution but were not concerned about the problem. This is attributed to the existence of many "higher priority" health problems. Comparisons are made between responses of respondents from varying socio-cultural backgrounds.

345.

Blomeke, J.O., and Perona, J.J. "Source terms for airborne effluents." *Controlling Airborne Effluents from Fuel Cycle Plants*. Hinsdale, Illinois: American Nuclear Society, 1976.

The characteristics of radioactive wastes from the nuclear fuel cycle depend on the types of operating characteristics of the reactors, the processes for flowsheets used in manufacturing and reprocessing the fuels, and the waste management operating practices adapted at the plants. The wastes of greatest concern are generated by fuel preparation, fabrication, and reprocessing operations. The following wastes are defined and characterized: high-level wastes, cladding, noble gases, I, tritium, ^{14}C, low-level transuranic (TRU) wastes, intermediate-level TRU wastes, non-TRU wastes, and ore tailings. Reference flowsheets are presented depicting current practice for LWR fuels and for off-gas cleanup from HTGR fuels. To project the quantities and characteristics of fuel cycle wastes, the central station nuclear electric power generating capacity is forecast through the year 2000. The vol, activities, shipping requirements, and relative toxicities of principal types of fuel cycle wastes are also forecast for the year 2000. The projected accumulations of noble-gas fission products, fission product I, ^{14}C, tritium from reactors, and fission product tritium are tabulated; and the global buildup of ^{85}Kr, ^{14}C, ^{129}I and ^{3}H is discussed.

346.

Buechley, R., et.al. "SO_2 levels and perturbations in mortality. A study in the New York - New Jersey metropolis." Archives of Environmental Health, Vol. #27: pages 134-137 (1973).

An analysis of daily mortality for 422 places in the United States during the period 1962-1966 revealed three types of influence (i) an annual cycle, day of the week and Christmas holidays, (ii) influenza epidemics, and (iii) days or spells of extreme cold or heat. In the New York metropolis daily SO_2 measurements were also found to have an influence. Mortality was 1.5% less than expected on 232 days with SO_2 levels below 30 ug/m^3, and 2% greater than expected on 260 days with SO_2 levels above 500 ug/m^3 after correction for the other influences. The coefficient of haze (COHS) showed a similar relationship. Similar, but less pronounced, effects were found in Philadelphia.

347.

Bustueva, K. "Inter-action of air pollutants." In: Recent Advances in Assessment of the Health Effects of Environmental Pollution, International Symposium. Paris, France: World Health Organization, 1974.

In evaluating the health effects of chemical and physical factors, it is of great importance to know the possible interactions between different pollutants. The biological effects of interactions, when present, may be synergistic, antagonistic or additive. Each type of interaction calls for a different evaluation and different practical measures. As yet the understanding of such effects is not clear, probably because of differing definitions of terminology. For example, the combined effect of sulfur dioxide and particulates is interpreted as a synergistic effect; in the author's opinion, this is an aggravating effect. The type of interaction depends on the levels of concentration observed--for example, the synergism shown at high levels of concentration is not always demonstrated for low levels of concentration. In fact there is little evidence of synergistic effects from ambient air pollutants; the more common type of interaction is additive in effect.

348.

Cleary, G., et.al. "Air pollution in native huts in the highlands of New Guinea." Archives of Environmental Health, Vol. #17: pages 785-794 (1968).

It was thought that air pollution in native huts in the New Guinea Highlands might be a factor in both initiating and in contributing to the progress of the non-tubercular lung disease prevalent among New Guinea highlanders. In the

Eastern Highlands, at an altitude of 7,200 feet, measurements were made of the concentrations of smoke, aldehydes, and carbon monoxide. "Average" concentrations were 666 ug/m^3, 1.08 ppm, and 213 ppm, respectively (peak values of 4862 ug/m^3, 3.8 ppm, and 150 ppm, respectively, obtained during the lighting of a fire were excluded from the calculations). Comparable average values in the Western Highlands at 4,000 to 5,200 feet were 359 ug/m^3, 0.67 ppm, and 11.3 ppm, respectively. In both areas smoke density was found to be highly correlated with aldehyde concentrations (r = +0.93 and 0.88) and with carbon monoxide (r = +0.87 and +0.72).

349.

Cresswell, C.R. Notes on Air Pollution Control, London: H.K. Lewis and Company, Ltd., 1974.

A condensed version of published material is presented to assist public health and other students interested in the control of air pollution. The nature and influencing factors of air pollution, measurements, and cost and effects are discussed. Topics include combustion and analysis of flue gases, measurements and transfer of heat; electricity and nuclear power; boiler and furnace operation; solid, liquid, and gaseous fuels; smoke and sulfur dioxide; grit and dust; and internal-combustion engines. Also covered are the control of domestic air pollution, pollution-producing industries, and common pollutants.

350.

Dave, J.M. "Basic needs in air monitoring in a developing country." International Conference on Environmental Sensing and Assessment, Vol. #1: page 5, New York: Institute of Electrical and Electronics Engineers (1976).

Air pollution in India is becoming increasingly important in the wake of rapid industrialization. Lack of adequate data, technical personnel, equipment, and laboratory facilities hamper national air pollution control measures. Appropriate techniques are under development for the assessment of air pollution status in urban and industrial areas to suit local situations such as manpower, equipment and facilities, legal status of authorities and agencies, meteorological factors, and the nature of the pollution. The pattern of the monitoring systems, is discussed.

351.

Douglas, J., & Waller, R. "Air pollution and respiratory infection in children." British Journal of Preventive and Social Medicine, Vol. #20: pages 1-8 (1966).

As part of the National Survey of Health and Development, information was obtained on the health of a sample of children from their birth in 1946 until 1961. The areas of residence of the 3,866 children in the authors' study were classified according to estimated atmospheric pollution based primarily on domestic coal consumption. Health visitors, schools and school doctors and hospitals cooperated in obtaining medical data. It was found that upper respiratory tract infections were not related to the degree of air pollution. The frequency and severity of lower respiratory tract infections, however, increased with the amount of air pollution. This was found at each age examined, and the relationship appeared to persist until the end of the observation period on leaving school. No differences were detected between boys and girls, or between children of middle or working class parents.

352.

Goldsmith, J. In: (ed) Stern, A.C. Air Pollution, New York and London: Academic Press, 1968.

This chapter provides an extensive discussion of the human health effects associated with air pollution.

353.

Haddad, R. "Air pollution problems in Latin America." In: Recent Advances in Assessment of the Health Effects of Environmental Pollution, International Symposium. Paris, France: World Health Organization, 1974.

The Pan American Health Organization coordinates a network of Air Pollution Sampling Stations, which includes at present 84 stations in 25 cities of 14 countries. The results of 6 years of international cooperation of the Network are presented, showing actual concentrations and trends for SO_2 and particulates. A summary of the findings of several health effects oriented research developed in Chile, Mexico, Peru and other countries are also included. The differences between doses/effects relationships as measured at sea level, in comparison with those observed at high altitudes, are discussed.

354.

Hann, S.R. "Local and global transport and dispersion of airborne effluents." Controlling Airborne Effluents From Fuel Cycle Plants. Hinsdale, Ill.: American Nuclear Society, 1976.

Several wind tunnel and field tests involving the interference of source buildings on diffusion have been done, and a model of mixing in the wake is presented. The graphic and anlytical techniques recommended by Gifford for conventional sources where the crosswind distribution of pollutant concentration is Gaussian are described, and Van der Hoven's study of short range dispersion under stable, light-wind conditions is summarized. Horst has developed a surface depletion method of estimating dry deposition that is more physically realistic and effective than the source depletion method. New ways of estimating the rate of resuspension of pollutant particles lying on the surface are being developed, and chemical transformations and precipitation scavenging are being studied. Experiments on diffusion in mountainous terrain and in shoreline environments have been conducted. These experiments are discussed along with methods of estimating the trajectories of pollutant clouds based on observed winds which can be combined with a Monte Carlo estimate of diffusion to predict concentrations due to nuclear explosions. At global scales, transport and diffusion must be estimated on the basis of observations of the spread of tracer materials such as volcanic or nuclear cloud debris. The model by Machta, which is capable of reproducing some of the long-term characteristics of the mixing of pollutants on a global scale is also discussed.

355.

Kumpf, J., Arhirii, M., Grab, B., and Suess, M.J. "Study on long-term effects of health of air pollution." In: Recent Advances in Assessment of the Health Effects of Environmental Pollution, International Symposium. Paris, France: World Health Organization, 1974.

Epidemiological studies are required in order to ascertain the long-term effects on health of exposure to relatively moderate levels of pollution of ambient air. To avoid the influence of other factors, such as occupational exposure and smoking, studies on children have been recommended. School children 8-10 years old, living in areas with different levels of air pollution, divided into "highly polluted" (annual median concentration of SO_2 more than 100 ug/m^3 and annual median concentration of standard smoke over 40 ug/m^3) and "low polluted" (SO_2 below 50 ug/m^3; standard smoke below 30 ug/m^3) are investigated by means of a questionnaire filled in by parents or guardians, and by means of lung infection tests (Peak Flow Rate, FEV. 0.75 and FVC). Using a common working protocol and reporting forms, studies are currently carried out in five European countries. The results obtained in 1972 and 1973 studies will be analyzed by a Working Group to meet in Dusseldorf in April, 1974.

356.

Lao, R.C., Thomas, R.S., Dubois, L., and Monkman, J.L. "Improved methods of sampling and analysis of ambient hazardous particulare pollutants." In: Recent Advances in Assessment of the Health Effects of Environmental Pollution, International Symposium. Paris, France: World Health Organization, 1974.

The collection, identification and measurement of airborne particulate matter continue to be primary goals of environmental assessment surveys. A broad spectrum of inorganic and organic pollutants posing a potential human hazard are collected by filtration and analyzed by a selection of techniques. Attention has been focussed on those compounds whose assayed biological activity has demonstrated carcingenecity (sic) or high toxicity at ambient levels. Notable among the class of pollutants are the polycyclic aromatic hydrocarbons (PAH) and compounds of arsenic, selenium and mercury.

357.

Lawther, P. "Air pollution and exacerbations of bronchitis." Thorax, Vol. #25: pages 525-539 (1970)

The simple diary technique described by Lawther (1958, 1959) and by Waller et.al. (1969), used for demonstrating the effects of air pollution on the daily condition of chronic bronchitis patients, is here described in detail. There is some evidence that patients are more sensitive to the effects of pollution at the beginning of each winter. Comparative studies are continuing in order to define any change in response following the definite reduction in London's smoke pollution. The results indicate some decline in the response of patients to specified concentrations of sulphur dioxide, but in recent years there have been few days on which pollution has been high enough to produce any response.

358.

Lawther, P. "Chronic bronchitis and air pollution." Proceedings of the Royal Society of Health, Vol. #1: page 4 (1959).

Earlier work on air pollution in London has shown that episodes of high pollution were accompanied by an abrupt rise in mortality and morbidity, patients suffering from respiratory diseases being particularly at risk. In these two papers the author follows groups of patients suffering from chronic bronchitis through the winter months using a simple diary technique in which each patient recorded daily whether he was feeling better, the same, worse or much worse. The state of the group was plotted against indices of temperature, humidity and pollution. A relationship between the degree of air pollution and the subjective feelings of the patients was demonstrated. This relationship disappeared with the onset of spring.

359.

Master, K.M. "Air pollution in New Guinea." Journal of the American Medical Association, Vol. #228: pages 1653-1655 (1974)

The inhabitants of villages in the Highlands of New Guinea wear little clothing and, to keep warm on cold nights, burn smoky wood fires in their small closed huts, thus inhaling high concentrations of particulate matter and aldehydes. Obstructive and restrictive pulmonary disease appears at an early age and was present in 78% of subjects over the age of 40. The clinical and post mortem features of the condition are described. Men and women over the age of 40 had an equal incidence of abnormal pulmonary physical findings, and smokers had a significantly higher incidence of such findings than the nonsmokers. In addition to the smoking of home grown tobacco, the other predisposing or associated factors may include protein malnutrition, poor sanitation and various endemic diseases.

360.

McCarroll, J. & Bradley, W. "Excess mortality as an indicator of health effects of air pollution." American Journal of Public Health, Vol. #56: pages 1933-1942 (1966).

The authors examined the total deaths in New York City, classified by day of occurrence, and found peaks of mortality associated with episodes of high air pollution. These usually occurred at times when there was little wind, and a temperature inversion; fog was not always present. The rise in mortality was immediate, usually on the same day as the increase in air pollution, and the elderly and later-middle-aged were found to be most at risk. The features were similar to those described for Greater London.

361.

Menzel, D.B. Oxidants and human health., Journal of Occupational Medicine, Vol. #18 (5): page 342 (1976).

This paper provides a brief summary of the health effects of some airborne oxidants. Effects of short term vs long term exposures and the mechanisms of action on the human body are discussed.

362.

Molski, B.A., "Tree belts as a protection against the harmattan in Nigeria." International Clean Air Congress, Proceedings, Part 1, London, 1966.

Air pollution in West Africa is mainly due to the "harmattan" winds that carry dust from the north during the dry season. This time is associated with higher incidence of certain diseases such as cerebrospinal meningitis and also problems of irritation to the mucous membrances. This paper discusses a method of lessening the effects of the inevitable "harmattan" by reforestation to slow down the transport of dust and increase the local humidity level. This is an applied method that might provide useful information about reforestation.

363.

Morris, S.C. and Shapiro, M.A. "Uses of mortality as a measure of the health effects of air pollution." In: Recent Advances in Assessment of the Health Effects of Environmental Pollution, International Symposium. Paris, France: World Health Organization, 1974.

The data obtained in a thirteen year follow-up of mortality in Seward and New Florence, Pennsylvania, USA, were used to compare the results obtained from the use of several methodological techniques in the study of mortality differences. Seward, the site of a coal fired electric power plant, has been subjected to air pollution levels several times that of New Florence. Measures of air pollution levels in both communities were available. Sample populations drawn from the two communities in 1960 formed the base population for the follow-up.

364.

Mustafa, M. Personal communication regarding the status of air pollution problems in the developing countries. 1977.

Air pollution concerns and hazards in the developing countries are discussed. The author suggests that the extent of these problems cannot be adequately assessed until data is collected. Typical pollutants and the environments in which they are contacted are described.

365.

Ozesmi, M., Kerse, I., et.al. An outbreak of pleural mesothelioma in the village of Karain Urgup-Anatolia. Kanser 5 (2): 63 (1975)

The evidence of cancer in the village of Karain Urgup-Anatolia was high due to pleural mesothelioma, which had a prevalence of at least 1.3%. The same living conditions exist in many rural areas of Turkey, indicating the possibility of an unusually high incidence of pleural mesothelioma in this country. The outbreak in Karain can be attributed to the inhalation of dust while cultivating potatoes and scallions.

161

366.

Paccagnella, B., Pavanello, R., and Pesarin, F. Archives of Environmental Health, Vol. #18: pages 495-502 (1969)

Cited in WHO, 1972, Health Hazards of the Human Environment.

367.

Perry, R., and Twibell, J.D. "Specific hydrocarbon monitoring at low concentrations." In: Recent Advances in Assessment of the Health Effects of Environmental Pollution, International Symposium. Paris, France: World Health Organization, 1974.

One of the major problems involved in studying the medical effects of individual hydrocarbon air pollutants is that of sampling, at street air concentrations, in such a way as to render subsequent separation and analysis possible. If, for instance, adsorption tubes containing standard chromatographic materials are used at sub ambient temperatures, difficulties arise with water condensation. In addition the amounts of volatile materials collected are limited by the relatively low retention volumes involved. These problems of sampling and analysis can be overcome by use of the "Timed Elution Procedure". Here the hydrocarbons are sampled quantitatively at ambient temperatures by adsorption onto Chromosorb 102 packed into stainless steel tubes. These tubes are then heated to 130°C and a proportion of the collected material is eluted via a sampling valve onto the main chromatographic column for analysis. The elution is accurately timed over a short period such that the sample is rapidly introduced, in a small plug of carrier gas, onto the column. For a given sampling tube, the proportion of each species eluted in this timed-interval is a linear function of the total amount collected. The elution procedure may be repeated several times for the same sample allowing both quantitative analysis and, if necessary, G.C./M.S. identification of the species present.

This technique allows, for example, street air benzene levels to be readily assessed. It is also important in that it is within the C_6 - C_{10} hydrocarbon range that petrol and diesel exhaust emissions differ most markedly. These hydrocarbons can be readily sampled and separated by this method and their relative contributions to the street air hydrocarbon levels may be measured. Very low levels of alkylbenzenes, indans and tetralins, which contribute to exhaust odor can also be estimated. The techniques described are currently being used in a survey of the region around Heathrow Airport, London. Benzene levels are being determined and the relative contributions to total hydrocarbon levels from petrol, diesel and aircraft engines are being assessed.

368.

Remmers, J.E. and Balchum, O.J. "Effects of Los Angeles urban air pollution upon respiratory function of emphysematous patients." In: Proceedings of the 58th Meeting of the Air Pollution Control Association, Toronto, 1965.

Cited in WHO, 1972, Health Hazards of the Human Environment.

369.

Richardson, A.C.B. "EPA's role in the control of airborne effluents from fuel cycle plants." *Controlling Airborne Effluents From Fuel Cycle Plants*. Hinsdale, Ill.: American Nuclear Society, 1976.

The EPA has the authority to establish generally applicable environmental standards for the protection of the general environment from radioactive material. Such standards should be related to the source of the radiation and should take into account the cost associated with achieving the level of protection attained. The EPA's standards for the U fuel cycle, which are proposed under this authority, are discussed from an historical perspective. The rationale upon which the standards are based and their anticipated impact on public health and the industry itself are also discussed. In 1960, the Federal Radiation Council proposed a series of numerical individual dose guides that represented an acceptable radiation risk to individuals, independent of the cause of the exposure. Since then the growth of the nuclear power industry, the enactment of NEPA, and progress in providing specific numerical estimates of radiation risk have had important implications for radiation standards of nuclear power. Presently, judgments for standards are based on the linear nonthreshold dose-effect relationship. The benefits associated with an activity producing public radiation exposure and the cost-effectiveness of risk-reduction through effluent control are examined. The concept of total population dose commitment is used to assess the impact of an environmental release, and explicit estimates of health effects rather than dose are used as the endpoint to be minimized by standards. In general, the proposed standards are lower than existing ones by a factor of 20 and provide additional protection against long-term exposures of humans by long-lived materials. They apply to operations defined to be part of the commercial U fuel cycle. The limits, which are expressed in terms of maximum dose to any real individual, are summarized.

370.

Rokaw, S.N. and Massey, F. *American Review of Respiratory Disease*, Vol. #86: pages 703-704 (1962).

Cited in WHO, 1972. *Health Hazards of the Human Environment*.

371.

Schoettlin, C.E. *American Review of Respiratory Disease*, Vol. #86: pages 878-897 (1962).

Cited in WHO, 1972, *Health Hazards of the Human Environment*.

372.

Sofoluwe, G.O. "Smoke pollution in dwellings of infants with bronchopneumonia." *Archives of Environmental Health*, Vol. #16: pages 670-672 (1968).

Wood is the commonest fuel used for cooking in the poorer homes of Lagos, and there is often an accumulation of fumes in the living rooms. Measurements were made of carbon monoxide, nitrogen dioxide, sulfur dioxide, and aromatic hydrocarbons, and high levels were found. The author points out that with the exception of carbon monoxide, these substances can lead to bronchial irritation, and he considers that the smoke and fume pollution in the dwellings may be an important causal factor in the bronchiolitis and bronchopneumonia observed in infants.

373.

Spicer, W.S. Archives of Environmental Health, Vol. #14: pages 185-188 (1967).

Cited in WHO, 1972, Health Hazards of the Human Environment.

374.

Stern, A.C., Air Pollution, 2nd ed., New York: Academic Press, Inc., 1968.

This text provides extensive information on air pollution. Included are chapters on the history of air pollution worldwide, the types of pollutants produced by different sources and the relationship of such physiographic factors as geology, climatology, and temperature on pollutant levels. The various chemical reactions involved in the production of pollutants are detailed. Surveillance and control technologies are elaborated as are procedures for laboratory tests. Currently accepted or speculated health effects of air pollutants are discussed and mechanisms of action are detailed when available. This text provides both theoretical and applied methodologies for control, monitoring and prevention of air pollution. It is one of the most comprehensive texts available in its field. Emphasis is not placed on issues pertaining to developing countries.

375.

Stewart, R.D., "The effect of carbon monoxide on humans." Journal of Occupational Medicine, Vol. #18 (5): pages 304-309 (1976).

This review covers the recent scientific literature which reports the effects of exposure to low (lower than experienced by tobacco smokers) concentrations of CO (carbon monoxide) upon humans, and examines the situations which result in saturation of carboxyhemoglobin (COHb) below 15%, saturations which generally do not result in signs or symptoms of overt intoxication in healthy individuals. First, the expected and unexpected sources of CO are itemized, then the basic pathophysiology of the gas is summarized and finally the reported effects of CO on human cognitive performance and the cardiovascular system are analyzed. The primary effect on humans of exposure to low concentrations of CO results from the hypoxic stress secondary to the reduction in the oxygen carrying capacity of the blood. Healthy humans are exquisitely sensitive to any hypoxic stress, immediately compensating by increasing cardiac output and flow to critical organs. Humans with advanced cardiovascular disease may not be able to compensate adequately and are at risk of injury from the CO induced hypoxic stress.

376.

Symon, K. "The child population as an indicator of the health effects of air pollution." In: Recent Advances in Assessment of the Health Effects of Environmental Pollution, International Symposium. Paris, France: World Health Organization, 1974.

Air pollution effects on the health of the population may be studied by means of diverse methods on different population groups. It is of advantage to conduct such studies on susceptible groups, e.g., children, sick persons or the aged. We have had the best experiences with child groups of 9-11 years. Group selection must ensure homogeneity between the exposed and control groups, sufficient numerosity (at least 120 children, 60 boys and 60 girls to a group) and equality of living conditions in terms of the socioeconomic, climatic and dietary background. Indicators of the health effects of air pollution may comprise anthropometric values (weight, height, proportions), blood indices (erythrocyte count and size, haematocrit, haemoglobin, color index, erythrogram, etc.), other biochemical indicators such as erythrocyte-glutathion values, values for some enzymes (alkaline phosphatase, etc.) or the composition and mutual ratios of blood-serum proteins (albumins, globulins). An apt index of bodily growth is also bone maturation or bone age in relation to calendar age. Changes may furthermore be found in the immunoreactivity of the child organism by investigating secretory immunoglobulin-A levels upon the upper-respiratory-tract mucosa or muramidase-lysozyme levels in the saliva. Some further outstanding indicators or air pollution effects are the state of the cervical lymph nodes, the tonsils including their microflora and the mucous membranes of the upper respiratory tract. The general clinical examination of the respiratory tract is aptly supplemented by respiratory-function values (forced expiratory volume, FEV), etc. In order to obtain valid and comparable data, examination of the children should be organized twice a year (in spring and autumn as a rule), in the exposed and control groups simultaneously and should be conducted by the same team of workers and for three consecutive years (i.e., on a semilongitudinal basis). The results obtained are processed and then compared by the group-evaluation method. In studying the effects of air polluted by specific noxae, specific indicators may also be used. For instance, arsenic intake may be estimated from As levels in the hair, the effects of nitrogen oxides from methaemoglobin levels, etc. Our experiences show that systematic examination of child groups may be a suitable method for evaluating the air-pollution impact on the health of the human population.

377.

Taga, T., "Continental Report: Asia," International Clean Air Congress, Proceedings, Part 1, London, 1966.

The air pollution status of a few Asian countries are briefly described based on government-supplied data. Only Formosa, Phillipine Republic and India were reported on by the respective countries. This section reflects the information which the respective governments wished to divulge and may be useful only to provide a general understanding of some of the air pollution concerns in this part of the world. No technologies or solutions are presented.

378.

Thofern, E. and Tolon, M. "Atmospheric pollution and its significance for health." Turk Hijiyen Tecrubi Biyol Derg 33 (2-3): 96-102 (1974)

A brief survey is given of the substances contributing to atmospheric pollution and their sources, and the harmful effects of some of these on human health are mentioned. The air pollutants discussed include dust, carbon monoxide, sulfur oxides, nitrogen oxides, hydrocarbons, lead and lead compounds, fluorine compounds, hydrochloric acid and highly odorous gases and vapors, such as hydrogen sulfide, phenols, amines and aldehydes.

379.

Vaughan, B.E., Wildung, R.E. and Fuquay, J.J. "Transport of airborne effluents to man via the food chain." Controlling Airborne Effluents From Fuel Cycle Plants, Hinsdale, Ill.: American Nuclear Society, 1976.

The literature on environmental behavior of various elements is critically reviewed with emphasis on recent developments in trace metal behavior and current studies on radioactivity uptake processes in green plants and the soil system. Plant retention of deposited materials is controlled by the size of particulate matter and possibly assessment models, however, due to the use of inappropriate data for the low-level chronic release situation where foliar uptake may be the dominant route of entry to green plants with very efficient retention. After foliar deposition of Pu and Sr, the small particles are held tightly by leaves with 80% or higher long-term retention. This may also be true for Cs, Ce, Na, Cd and Zn. In many field studies, estimates of the plant-soil concentration ratio (CR) represent an operational definition in which foliar processes of sorption are confounded with root uptake. This is manifested by a range of plant-soil CR values that differ by 10^5 for a given radioelement. Analysis of experimental data on soil processes under controlled conditions indicates that a range of 10^3 for Pu CR's would be expected. Higher CR's for Pu are seen in the field, indicating foliar uptake. Although Am has been less systematically studied, its higher CR values are associated with chelated forms which maintain its solubility in the soil system, thus affecting the extent of root absorption in plants. In some cases, particularly with ^{99}Tc, the concept of CR may be questionable; but when plant-soil CR's exceed 0.4 or gastrointestinal absorption fractions exceed 10^{-4}, the food chain pathway will be quantitatively more important than the inhalation pathway, for particles of respirable size range.

380.

Waldbott, G.L., Health Effects of Environmental Pollutants, St. Louis, Mo.: The C.V. Mosby Company, 1973.

This text provides an extensive discussion and description of pollutants; their sources, actions, interactions and health effects. Pollutants are classified according to their effects on the human body such as fibrosis-producing, granuloma-producing, and fever-producing agents. Additional groups of agents include asphyxiants, systemic poisons, allergenics, carcinogens, and mutagens.

Special situations causing high levels of exposure such as economic poisons (including pesticides), pollution by radioactive substances, smoking, water pollution and fires are described. A comprehensive study of pollutants is provided. The information presented may be relevant internationally although not specifically geared to developing nations.

381.

Waller, R.E. et.al. "Clean air and health in London." Proceedings of the Annual Conference of the National Society for Clean Air, pages 71-79 (1969)

The investigations of daily variations in mortality and morbidity described by Lawther (1958, 1959) Martin & Bradley (1960) and Martin (1964) have been continued with the object of monitoring the effects of London's clean air programme. During the intervening 10 years there was a spectacular reduction in ground level concentrations of smoke and a slight decline in sulphur dioxide levels. There was an important pollution episode in December, 1962, in which concentrations of sulfur dioxide were similar to those of the notorious polluted fog of December, 1952, but there was much less smoke in 1962. The increase in mortality and morbidity was much lower than in 1952. Since the winter of 1962-63 there have been few periods of high pollution and there has been a virtual disappearance of the relationship between mortality and morbidity curves and pollution.

382.

Winkelstein, W. Archives of Environmental Health, Vol. #14: pages 162-169 (1967).

Cited in WHO, 1972, Health Hazards of the Human Environment.

383.

Winkelstein, W. Archives of Environmental Health, Vol. #16: pages 401-405 (1968).

Cited in WHO, 1972, Health Hazards of the Human Environment.

384.

Winkelstein, W. Archives of Environmental Health, Vol. #18: pages 544-547 (1969)

Cited in WHO, 1972, Health Hazards of the Human Environment.

385.

Mexican air monitoring program: July-December 1973. Instituto Nacional de Energia Nuclear, Mexico, D.F. Radiation Data and Reports, Vol. #15: pages 277-278 (1974).

Results are provided of particulate air sampling at 6 stations in Mexico. Highest concentrations of gross B radioactivity in airborne particulates were detected at Torreon (0.27 pCi/m^3) and Veracruz (0.26 pCi/m^3). Average concentrations at all stations ranged from 0.05 to 0.13 pCi/m^3.

386.

Royal College of Physicians of London. Air Pollution and Health, London: Pitman Medical & Scientific Publishing Co., 1970.

This is an easily read, authoritative report of a committee set up by the Royal College in 1959 to look into smoking and atmospheric pollution in relation to lung cancer and other illnesses. It surveys the general problems of air pollution, its nature, effects, and the preventive measures which are needed. Three main sources of pollution--domestic fires, industry, and transport (including motor vehicles)--are considered, and the point is made that most of the pollution likely to affect health comes from the burning of coal on domestic fires. The major part of the report deals with health effects and, in particular, the effects on the respiratory system. Comparisons are made with the position in other countries. Chronic bronchitis is treated at length, and an important section deals with the effects of pollution on young children. Possible relationships with lung cancer are discussed and it is concluded that the evidence on the role of air pollution in its causation is still inconclusive. Throughout the report the comparative effects of cigarette smoking are kept in mind and it is evident that further research is needed into the combined effects of air pollution and smoking. British clean air legislation is described, and the report concludes with a list of observations and recommendations. There is a useful bibliography of 142 references.

FOOD SANITATION

387.

Aleksandrowicz, J., Czachor, M., Schiffer, Z., and Smyk, B. "Mycotoxins and their role in onchogenesis with special reference to blood diseases." Haematol Lat, Vol. #13 (2): pages 115-124 (1970).

This paper discusses the disease relationships to mycotoxin exposure. The primary diseases described are bone marrow diseases and cancer. The existence of these toxins in both food and soil is discussed and incidences of diseases associated with mycotoxin exposure are reported from Mozambique, South Africa and the USSR.

388.

Higgins, I.T.T., "Importance of epidemiological studies relating to hazards of food and environment." British Medical Bulletin, Vol. 31 (3): p. 230-235 (1975).

The author stresses the role of epidemiology in the evaluation of chemical health hazards. Illustrative examples of the utility of epidemiology are provided: illness associated with gross contamination, illness associated with exposure to low concentrations of chemicals, water hardness and cardiovascular disease, environmental causes of cancer, environmental exposures and congenital malformations. Dose-response relations are discussed; their importance in the study of environmental health. This paper provides a rationale for incorporating epidemiological techniques into the gathering and compilation of environmental health data.

389.

Kwon, T.W. By-product recovery as a resource. In: Environmental Quality and Food Supply, Futura Publishing Co., Inc., 1974.

With the growth of populations and increasing industrialization there is increasing food production and therefore by-product production as well. These may cause major pollution problems. This paper proposes some alternative methods of utilizing some of these wastes produced in the Asian countries as well as domestic sewage sludge. The economic feasibilities of some of these alternatives vary with the particular countries. The concept of by-product recovery may be a valuable consideration for some of the urban areas of developing countries. The specific materials and techniques for reuse are highly variable.

390.

Okpala, I. "A survey of the incidence of blood, urinary and intestinal parasites among students and kitchen personnel of the University of Nigeria, Nsukka." West African Medical Journal, Vol. #20 (3): pages 260-262 (1971).

This paper surveys the incidence of certain protozoan and helminthic parasitic diseases in students and food handlers. The relationship of these diseases to improper sanitary measures and disease transmission through food are discussed.

391.

Seligman, R. and Cohen, A. "Utensil swab test: its effectiveness in food service sanitation programs." Archives of Environmental Health, Vol. 30 (4): p. 201-204 (1975).

The effectiveness of the utensil swab test as part of the periodic inspection of food establishments was studied both as an indicator of cleanliness during the period between inspections and as an educational tool. Two to seven samplings were taken at intervals of two to three months at ninety-five food establishments in rural areas in the northern part of Israel. A statistical analysis showed a high variation and almost no correlation between repeated samplings of the same establishment. Also, no trend to suggest an educational effect was found. It was concluded that, though the swab test had proved to be useful in special projects, it had no value as part of the periodic sanitary inspections.

392.

Food hygiene. Report on a seminar convened by the Regional Office for Europe of the World Health Organization, Copenhagen: World Health Organization, 1971.

This document presents the results of a seminar on food hygiene. It discusses: food-borne infections and intoxications of public health importance in the WHO European Region, with particular reference to the tourist trade and food industries; prevention of food-borne diseases in relation to tourism and control of processing in food industries, requirements for food hygiene personnel and food handlers; principles of administrative and legislative measures in food hygiene; ways in which WHO could further promote and coordinate, both nationally and internationally, the development of the surveillance and prevention of food-borne diseases through the better utilization of existing resources and facilities.

393.

"Joint FAO/WHO Expert Committee on Meat Hygiene." WHO Technical Report Series No. 241. Geneva: WHO, 1962.

This report provides a discussion of the problems associated with the maintenance and delivery of hygienic meat. Topics discussed include: principal diseases associated with ingestion or contact with meat, reporting and investigation of food-borne infections and intoxications, handling of animals, methods of slaughter, meat inspection, refrigeration, transport, handling, sanitation of shops and restaurants, laboratory methods, education and training of inspectors, and special problems related to the tropical and developing countries.

394.

"Joint FAO/WHO Expert Committee on Milk Hygiene." WHO Technical Report Series No. 453. Geneva: WHO, 1970.

This report on milk hygiene discusses the theories and practices of milk hygiene in production, collection, transport, and handling and processing in the dairy. Sterilization and hygiene control of milk products are discussed. The bacteriology and toxicology of dairy products is presented and problems unique to warm countries are discussed. A final section deals with organization and administration of milk hygiene control programs.

395.

"Microbiological aspects of food hygiene." WHO Technical Report Series No. 399. Geneva: WHO, 1968.

Certain concepts basic to an understanding of the microbiology of food hygiene are provided. Principal organisms causing infection or intoxication and the technology required for their prevention are described. Particularly susceptible foodstuffs such as meat, dairy products and raw foods are discussed. Laboratory methods, administration and training and their relationship to the control of food contamination are discussed.

NOISE

396.

Baade, P.K. "Household Noise problems." Journal of the Acoustic Society of America, Vol. #50: pages 1233-1235 (1971).

Noise control in the home involves the owners, neighbors, builders, contractors, installers and the manufacturers of house appliances, as well as the manufacturers and operators of equipment used in the vicinity of the home--from lawn mowers to airplanes. The difficulties in solving many of the noise problems are as much social and economic as technical. A plea is made for uniform sound ratings of equipment, for information on proper installation and use, and for realistic criteria on acceptable sound levels. The work of the Air-conditioning and Refrigeration Institute is cited as an example of what can be achieved.

397.

Barbaro, V., Garibaldi, F., Loizzo, A., Neroni, M., and Zapponi, G. "An experimental study of the effects of noise on the central nervous system. Modifications of the cerebral electrical activity of mice following various kinds of acoustic stimulations." In: Recent Advances in the Assessment of the Health Effects of Environmental Pollution, International Symposium. Paris, France: World Health Organization, 1974.

Experimentally it is possible to demonstrate several effects of noise on the central nervous system: e.g., by submitting animals (rats, mice) to sounds of particular characteristics and intensity convulsions can be elicited (audiogenic seizures). In present investigations more sophisticated apparatuses allow us to evidence fine changes in cerebral electrical activity of freely moving mice, bearing chronically implanted electrodes, following acoustic stimulations of various intensity and duration. These changes can be modified by the administration of some psychotropic drugs.

398.

Bell, A. "Noise: An occupational hazard and public health nuisance." (Public Health Paper, No. 30), Geneva: WHO 1966.

The subject is surveyed systematically in successive chapters. The chapter on community noise describes the increase in noise nuisance in various countries and the importance of the annoyance effects. Much can be done in the control of residental noise of industrial origin by the proper design and correct operation of machinery, the design of factories, and by town planning and zoning. Difficulties in the evaluation of residential noise are discussed. Suggestions are made for international action and for further research.

399.

Benichou, L., and Schmitt, B. "Myth and reality: the problems of noise in the home. Psychological discomfort and nuisance." Bordeaux Medicale, Vol. #5: pages 2757-2764 (1972).

The authors discuss phychological discomfort and nuisance attributable to noise in the home. Most of the available scientific data on the effects of noise comes from the field of industrial medicine and relates to physiopathological reactions. From the standpoint of the psychology of the individual, the factors of discomfort and damage are more difficult to evaluate. Age, personality, social milieu, and living arrangements are all significant. The concept of a "hidden dimension" is advanced, since the reactions to noise are in part dependent on space and space-tolerance. While the psychiatrist and the sociologist regard noise tolerance as a measure of adaptability of a group to its housing these aspects cannot be taken into account in building codes.

400.

Bragdon, C.R. "Influence of noise control on land use planning." Acoustical Society of America: 92d meeting. Acoustical Society of America. Journal, Vol. #60 (1): S7 (1976)

City planning, an established professional discipline for nearly 50 years, evolved from architecture and other physically related disciplines and broadened to include interest in social and environmental concerns. Zoning was the first land use planning technique to incorporate noise performance requirements. Many other land use planning techniques now consider noise, among other environmental factors. An inventory of planning techniques is presented. Drawing upon municipal, state, and federal experience, the success of the planning techniques is discussed. Recommendations are made for future action to encourage greater effectiveness.

401.

Bragdon, Clifford R. "Noise Control in urban planning." Journal of the Urban Planning and Development Division, Vol. #99: pages 15-23 (1973).

This paper discusses the impact of noise on health and a method for appraising implicated health effects of noise. The nature of various noise problems, especially those related to both air and ground transportation, are discussed. The possibilities for control of noise at the source, path and object are evaluated and the role of urban planning in lessening the impact of noise is assessed.

402.

Bugliarello, G., Alexandre, A., Barnes, J. and Wakstein, C. The Impact of Noise Pollution: A Socio-technological Introduction. New York: Pergamon Press, 1976.

Various effects of noise on the environment are investigated. The awareness of noise; the effects of noise on health; the ramifications of surface transportation; aircraft, industrial, construction and household noise; and the political economy of noise are discussed. An attempt is made to set noise pollution in the framework of the general class of problems society is endeavoring to solve.

403.

Cheremisinoff, P.N., Cheremisinoff, P.P., Allen, E.E., Bonano, E.J., Casciato, A.C., Cheremisinoff, N.P., Marsh, D., Patil, P.G., Schneider, A.J. and Wilson, C.E. Industrial Noise Control Handbook, Ann Arbor, Michigan: Ann Arbor Science Publishers, 1977.

Worker exposure to noise is a problem for business and industry. Studies show that exposure to high noise levels causes low working efficiency. Noise contributes to psychological and physiological ills such as nervous tension, heart disorders, and circulatory problems. Practical noise control applications are provided for creating a safe and productive work environment. Case histories show proven noise control techniques in industrial plants. OSHA requirements, community relations, impacts of industrial operations, instrumentation and measurement, systems design, and safety devices are discussed.

404.

Clay, P.E. "Noise--the fourth pollutant." 1977 TAPPI annual meeting: Conference papers. Atlanta, Ga.: Technical Association of the Pulp and Paper Industry, pages 23-27, 1977.

A general description of industrial noise and its regulation is presented. Noise control by designing noise out of the machine, isolating the noise source from the man, and isolating the man from the noise is discussed. An industrial society seems to be inherently noisy. This was a price paid for "progress" prior to controlling federal regulations, but this is not so any longer. Quality of life is the watchword, and this has been reaffirmed by stringent pollution control regulations and the increased level of awareness of the general public.

405.

Cooper Jr., W.A. "The effects of noise on people." In: (ed) Crocker, M.J. Reduction of Machinery Noise, pages 37-45, West Lafayette, Indiana: Purdue University, 1975.

There is a 10-million-fold difference between the faintest sound the human ear can detect and the loudest sound it can tolerate. Sounds from 15-20 Hz to 20 ≥ kHz are detectable. The anatomy of the outer, middle, and inner ear is described, and the chain of events initiated by sound waves impinging on the tympanic membrane is traced. Physical and psychological loudness are related, and the dependence among frequency, sound energy, and loudness is analyzed. The auditory effects of noise include sound masking, sensitivity loss, and permanent hearing damage; nonauditory effects are irritation, job performance deterioration, and physiological changes.

406.

Dixon, Ward W. and Fricke, James E. (eds.) Noise as a Public Health Hazard. Proceedings of the Conference, June 13-14, 1968, Washington: American Speech's Hearing Association, 1969.

Source not referenced.

407.

Fasold, W. "On the status of meeting noise protection requirements in industrial housing construction." Zeitschrift fur die Gesamte Hygiene, Vol. #13: pages 682-631 (1967)

Using the results of sound insulation in industrial buildings as a basis, the author discusses how far the demands for sound protection are satisfied by modern building techniques. Problems of air insulation and step-sound insulation of walls (joints), ceilings, floors, including bathroom floors, and floating floors (puggins) are discussed. Other problems include the transmission of sound from staircases to adjacent dwelling rooms and sound transmission by windows, doors and ventilation shafts. Recent technical developments are reviewed.

408.

Finkelman, J.M. "Effects of noise on human performance." Sound and Vibration, Vol. #10 (9): pages 26-28 (1975).

A random sequence of -0 digits was presented to 23 subjects via earphones at 1 digit/2 sec. interval. The subjects were required to repeat back the digit before the one last presented during the inter-digit interval. Environmental stress consisted of 80dB intermittent bursts of white noise presented at periodic and aperiodic intervals. The unpredictable noise conditions resulted in a mean of 8.0 errors on the subsidiary task while the predictable noise conditions resulted in a mean of only 4.0 errors. The difference between the predictable and unpredictable noise conditions appears to substantiate the efficacy of the information processing approach for measuring the effect of noise on human performance. It demonstrates the potential for performance degradation at physiologically safe levels of noise. If the individual is already loaded to the limits of his channel capacity by existing task and environmental demands (not including noise), the capacity that is usurped by noise will result in performance degradation.

409.

Friedman, J. and Globus, G. "Impact of environmental noise on sleep electrophysiology as measured in the home." Recent Advances in the Assessment of the Health Effects of Environmental Pollution. Vol II. Luxenbourg: Commission of the European Communities, Directorate General Scientific and Technical Information and Information Management, pages 507-511, 1975.

Backbround noise, electroencephalographic and electrooculographic signals, and time were recorded on a modified 4-track analogue tape recorder from 6 couples sleeping directly beneath the flight pattern at Los Angeles International Airport and from 5 couples in a quieter area of Los Angeles. There was less "deep sleep," more "light sleep," and more awakenings among the couples in the noisier area.

410.

Grognot, P. Horiz. Med., Nos. 120-125 (1965).

Cited in WHO, 1972, Health Hazards of the Human Environment.

411.

Harland, D.G. "Vibration and road traffic in the United Kingdom." In: Roads and the Urban Environment, pages 79-82, Paris: Organization for Economic Cooperation and Development, 1975.

Vibrations transmitted to the whole mass by its supporting surface are discussed. Vibrations at very high intensities can damage people but such damage is not likely for vibrations below the pain threshold. In assessing bother by vibration in the environment of a road, the perception threshold is probably the critical intensity. Vibrations from traffic arise from variations in the reaction force at the road-to-tire-contact patch and are principally influenced by the height of irregularities in the road; but some modest reduction of vibration may be possible by the careful redesign of lorry suspension. Measurements nearby and on United Kingdom roads show that only on the road, and then only close to a severe surface irregularity, do vibration intensities exceed the minor damage threshold and approach the pain threshold.

412.

Jonsson, E. and Sorensen, S. "On the influence of attitudes to the source on annoyance reactions to noise." Nord Hyg Tidskr, Vol. #48: pages 35-45 (1967).

Source not referenced.

413.

Kryter, K. "Non-auditory effects of environmental noise." American Journal of Public Health, Vol. #62: pages 389-398 (1972).

Scientific observations are presented and discussed. Stress reactions when continued for sufficiently long periods can be psychologically harmful, but it appears that psychological and non-auditory physiological responses to noise are transitory, though more research is needed. Physiological stress reactions are likely to be the result of frustration or anger, but again more research is needed. Because non-auditory physiological stress responses are often the result of interactions between specific behavioral activities and the noise, rather than the noise itself, research on lower animals cannot usually be extrapolated to man. Rodents and rabbits in particular should not be used.

414.

Kryter, K. The Effects of Noise on Man, New York & London: Academic Press 1970.

This is an exhaustive treatise on the subject, Part 1 dealing with the auditory system's responses to noise, and Part 2, of particular interest to the environmental hygienist, with subjective responses to noise. Important chapters deal with perceived noisiness (annoyance), environmental noise and its evaluation, general physiological responses to noise, and effects of noise on mental and motor performance. The author believes that man should be able to adapt physiologically to his noise environment with only transitory interference effects on physiological, mental and motor behavioral activities during the period of adaption. All other noticed effects of noise, including physiological stress reactions, are taken to be due to stimulus and the resulting response effects as associated with the noise by the individuals. Such effects, if inappropriately interpreted, lead to individual differences in behavior to noise and would tend to be eliminated with learning and experience. Indirectly aroused physiological stress reactions (fear, frustration, etc.) to many repeated exposures to a noise, if not eliminated through learning, would undoubtedly be harmful to mental and physical health.

415.

Levere, I.E. "Sleep disruption by auditory noise and its effect on waking performance." Recent Advances in the Assessment of the Health Effects of Environmental Pollution. Vol. II. Luxenbourg: Commission of the European Communities Directorate General Scientific and Technical Information and Information Management, pages 493-506, 1975.

Auditory stimulation of between 9 and 24 15-second presentations was applied to volunteer males, ages 18-35, sleeping for 3 nights within the laboratory bedroom setting. Sleeping reaction to the stimuli was determined by electroencephalogram. Effects of sleep disruption which carry over into wakefulness were measured by having subjects perform a behavioral task before retiring at night and upon arising in the morning. The data suggest that sleep is a qualitatively unique behavioral state necessary to an individual's well-being; and, if sleep is even minimally interfered with, optimal waking behavior may suffer.

416.

Mayer, C.L., Levitt, H. and Bergman, M. "Effect of aging on speech reception in noise." Acoustical Society of America: 91st meeting. In: Acoustical Society of America. Journal, Vol. #59 (1): S86.

An attempt was made to isolate the effect of aging for listeners of speech in noise. Chaba sentences of everyday American speech and monosyllabic word lists with a closed-set response (Mitchell Test of Phonemic Differentiation) were recorded by male and female speakers. The speech materials were systematically combined with subway and traffic noise samples. The tapes were presented in a balanced design to 160 listeners who represented a nonclinic population with essentially normal hearing. The subjects were divided into decade groups: 20-29 through 60-69, and the data were analyzed for each age group. Results show a decline in speech intelligibility scores for every condition presented. This effect was greatest where the speech:topnoise ratios were poorest.

417.

Merluzzi, F., Grieco, A., Morresi, N., Berna, M., and Donzelli, A. "Assessment of noise pollution from a thermal power plant and its effect on the neighborhood." In: Recent Advances in Assessment of the Health Effects of Environmental Pollution, International Symposium. Paris, France: World Health Organization, 1974.

The aim of the survey was to assess the effects of noise and mechanical vibrations produced by a thermal generating station on the inhabitants of a district in the Riviera Ligure region. Apart from conducting an objective survey consisting of direct measurements of noise and vibrations at the thermal generating station under operational and non-operational conditions, a "subjective" survey was carried out on the basis of a questionnaire on the opinions of the surrounding inhabitants. In order to ensure a large number of responses, an "active" and "passive" questionnaire was used, broken down into the two following categories: a study of problems strictly relating to the survey population and conditions; a questionnaire drawn up with the assistance and collaboration of as large a group as possible of interested subjects comparable with the functional and operative requirements of the survey.

418.

Mott, K.J. "Noise control in building development." Vibration and noise control engineering: Preprints of papers. 1976.

There is a need to anticipate noise problems associated with building projects, and this need extends to all members of the design team. The most common problems can be avoided to a large extent if developers, architects, builders, and engineers have a basic understanding of noise control. Some of the noise problems encountered in building design are presented and basic noise control methods are discussed.

419.

Olishifski, J.B. "Industrial noise and hearing conservation." NSC Occupational Safety Series, Chicago: National Safety Council, 1975.

The recognition, evaluation, and control of noise problems are described. Topics include the fundamental aspects of the noise problem, the physical and subjective aspects of sound, measurement of sound, the effects of noise on man, the control of noise and noise exposure, industrial audiometry, and industrial hearing conservation programs.

420.

Wahi, P.N. "Noise pollution and health." Indian Journal of Medical Research, Vol. #59 (7): pages 1148-1153 (1971).

This paper discusses the relationship between noise and health. The particular concerns of noise pollution in India are emphasized.

421.

Wisner, A. "Audition et bruits." In: (ed) Scherrer, J. Physiologie du Travail, Vol. #2: pages 3-72, Paris, Masson, 1967.

Cited in WHO, 1972, Health Hazards of the Human Environment.

422.

Yaniv, S.L. "Method for the identification of environmental noise levels to protect public health and welfare." Recent Advances in the Assessment of Health Effects of Environmental Pollution. Vol. III. Luxenbourg: Commission of the European Communities, Directorate General Scientific and Technical Information and Information Management, pages 1249-1262, 1975.

Accumulated evidence of research on human response to sound indicates that the magnitude of sound as a function of frequency and time are the basic indicators of human response. This fact had led the EPA to choose the equivalent A-weighted sound level, L_A, in dB as its basic measure for environmental noise. Acceptable acoustical environments from a public health viewpoint can be summarized in terms of yearly equivalent sound levels as follows: in residential areas, hospital, and other areas where people are expected to be present for prolonged periods of time, a day-night average sound level of 45 and 55 dB for indoor and outdoor areas, respectively; for areas where speech is of primary concern, an equivalent noise level of 45 indoors; and for those areas where hearing protection is of primary concern, an equivalent noise level of 70 dB irrespective of area.

HOUSING

423.

Benjamin, B. "Tuberculosis and social conditions in the Metropolitan Boroughs of London." British Journal of Tuberculosis and Diseases of the Chest, Vol. #47: pages 4-17 (1972).

Evidence of the etiology of tuberculosis has constantly pointed to an association with poor social conditions, but the elements in the environment involved and their relative importance have never been assessed with any degree of finality. In this paper the differential incidence of, and mortality from, pulmonary tuberculosis in the London boroughs has been considered alongside nine indices of social conditions including the proportion of males aged over 14 in social classes IV and V and the percentage of the population in private families living at a density of more than one-and-a-half persons per room. Multiple regression analysis on data for 1931, confirms earlier findings of the importance of socioeconomic factors. It is not possible to delineate satisfactorily the separate roles of income, housing, nutrition or occupation, but it is found that consideration of the proportion of social classes IV and V (a measure of income) and housing density of more than one-and-a-half persons per room, gives as good a guide as any to the expected variation of tuberculosis mortality between the boroughs at 1931. Morbidity variation is still largely unexplained. A brief account is given of the borough trends since 1931 in relation to the social background. (Author's summary modified.)

424.

Brand, F., & Smith, R. "Life adjustment and relocation of the elderly." Journal of Geronotology, Vol. 29: pages 336-340 (1974).

A group of 68 persons aged 65 and over who had been compulsorily relocated as a result of urban renewal were compared with a control group of 69 non-relocated persons. Social and psychological data were obtained by interview, and health status by physical examination. The relocated group showed higher scores of maladjustment as measured by the Life Satisfaction Index, particularly in the case of females and of persons in poor health. Blacks seemed to adjust better than whites. There was suggestive evidence that physical or social stress contributed to the problem of personal adjustment.

425.

Brett, G., & Benjamin, B. "Housing and tuberculosis in a mass radiography survey." British Journal of Preventive and Social Medicine, Vol. #11: pages 7-9 (1957).

The housing densities of 14,676 London households were considered in relation to the incidence of active respiratory tuberculosis discovered in a mass radiographic survey. The results indicated that those housed at a density of less than one per room experienced lower morbidity than the remainder, but there was no evidence of a rise in morbidity with the increased crowding. A similar absence of any effect of crowding was obtained when the group was subdivided according to social class; men in social classes IV and V showed a higher incidence than members of classes I, II & III. 1,160 one-person households (lodgers) were considered separately. Those in social classes IV and V had a particularly high incidence of active tuberculosis.

426.

Britten, R. "New light on the relation of housing to health." American Journal of Public Health, Vol. 32: pages 193-199 (1942).

A national health survey was undertaken in 1934-36, covering 703,092 urban and 36,801 rural families by house-to-house canvassing. Associations were established between crowding and a number of health indices, between sanitation and sanitary facilities and gastrointestinal infections, and between house values and home accidents. The difficulties of determining the effects of housing conditions per se, of other environmental circumstances, and of factors such as economic status, adequacy of medical care, and of nutrition are discussed. It is concluded that the inability to define the precise influence of the various elements of bad housing must not be an excuse for failing to make progress in improving housing conditions.

427.

Burt, W. "Poverty, housing, and health." Medical Journal of Australia, Vol. #2: pages 167-173 (1945).

The author refers to a study undertaken in 1936-7 in Melbourne, which showed that infant mortality was twice as high, and infectious disease rates three times as high, in areas of poor housing. He considers that the problems of slums are mainly the result of poverty and that the provision of proper housing should be regarded as an essential social service.

428.

Cappon, D. "Mental health in the high-rise." Canadian Journal of Public Health, Vol. #62: pages 426-431 (1971).

Studies of mental health problems of high-rise apartment dwellers are hampered by the complexity and interdependence of the numerous factors concerned, and the lack of guidelines for an operational definition of mental health. Inpairment of the latter is too gross a condition to be a demonstrable reaction to high-rise living and satisfactory methodologies, expertise, and adequate funds for carrying out investigations are not yet available for definitive studies. The author discusses concepts of mental health and advances an 'Index of Social Malaise' composed of psychiatric, social, medical, economic, and educational constituents. He outlines a scheme for the study of the mental effects and stresses the importance of looking at the environmental genesis in terms of perception and imagery since what really matters is the perceived and not the actual environment. The study would extend over a period of time to allow for changes in the maturity of the environments, in their acceptability, and in social attitudes. Until the results of such studies are available he claims there is sufficient evidence from case studies and observations to justify the suspension of further schemes for the erection of high-rise apartments.

429.

Chapin, F. "Some housing factors relating to mental hygiene." American Journal of Public Health, Vol. #41: pages 839-845 (1951).

Adequate housing contributes to good mental health, and the sound planning of a house, while not curing mental ill health, can often prevent further deterioration. Privacy and facilities for free circulation within the home are important and facilitate sound emotional and mental health, whereas when persons with an originally seclusive personality-trend, such as schizophrenics, are denied normal social contacts as often happens in slum housing, they tend to become more shut in and seclusive. The author stresses the need for more accurate and precise methods of measuring changes in human behavior.

430.

Colley, J., & Reid, D. "Urban and social origin of childhood bronchitis in England and Wales." British Medical Journal, Vol. #2: pages 213-217 (1970).

A survey was made of 10,887 children aged 6-10 in contrasting urban and rural areas of England and Wales. A pronounced social class gradient was found in the frequency of chronic cough, history of bronchitis, and in disease of the ears and nose. Among the children of semiskilled and unskilled workers (i.e., the children with the highest prevalence of chronic cough and bronchitis) there was a marked association of chest conditions with levels of air pollution. An excess rate in Wales, however, could not be explained by local levels of pollution. Geographical variations in the average number of persons per room, persons per dwelling, or rooms per dwelling were not large enough to explain the difference in rates.

431.

Dhar, G.M., Prasad, B.G., Mathur, Y.D., and Bhatnagar, J.K. "A study on housing conditions in village Rahimabad of Lucknow district." Indian Journal of Medical Research, Vol. #59 (12): pages 1906-1921 (1971).

A survey to appraise the existing position in regard to rural housing was carried out in village Rahimabad lying within the field practice area of Rural Health Training Center, Sarojini Hagar, Lucknow. The general pattern of the houses was a single storeyed kutcha or semi-pucka structure enclosing an inner courtyard. 50.56% houses were kutcha and only 8.33% pucka. The number of living rooms per house ranged from 1 to 7, with an average of 2.68. The number of inmates per house ranged from 1 to 16 with an average of 5.67. Ventilation was considered good in 80.13% living rooms. Lighting was good in 87.79% living rooms. Open shallow wells were present in 25.56% houses and handpumps in 3.33%. Latrines were absent in 95% houses, people using fields for defecation. 84.45% houses disposed of refuse by dumping into heaps. The waste water from 51.12% houses collected into cesspools. 83.33% disposed of animal wastes by dumping in heaps. Overall assessment of housing done through scoring method placed 67.78% houses in C or poor class and 20% in D or bad class.

432.

Fanning, D. "Families in flats." British Medical Journal, Vol. #4: pages 382-386 (1967).

A comparison was made of the health of 1,163 wives and children of British servicemen living in modern 3-4 storey flats on a housing estate in Germany, and 445 living in modern two storey houses. The morbidity among the families living in flats was 57% greater than among those living in houses, the greatest difference being in the prevalence of respiratory infections in young women and children and of psychoneurotic disorders among women. The relatively small space available in flats, together with the resulting confinement of the family, was thought to be an important factor leading to the increased occurrence of respiratory disease. Similarly, the confined conditions, with the resulting social isolation, were thought to be an important factor leading to the higher occurrence of psychoneuroses. (See also Leading Article on page 376 of same issue in which Fanning's use of "first consultation rates", admissions to hospital and referrals to specialists are discussed as indices of morbidity.)

433.

Grootenboer, E., "The relation of housing to behavior disorder." American Journal of Psychiatry, Vol. #119: pages 469-472 (1962).

The author, a consultant psychiatrist to the Municipal Mental Hygiene Service in Rotterdam, expresses concern over families where young parents and their families were sharing accommodation with the grandparents, and quotes a number of case histories. Four types of situation are described leading to behavioral disorders in the children: (1) the lack of privacy of the young parents in conducting their family affairs; (2) a state of rivalry between parents and grandparents for the love of the children; (3) the resulting lack of certainty in exercising control over the children; and (4) the lack of privacy of the parents in sexual activities. Conditions usually improved when parents moved to a home of their own, but in some cases a child missed its grandparents' display of affection, and felt lonely as a result. This could result in a disturbance of the child's emotional relationships with other children.

434.

Hare, E. "Mental health in new towns: what next?" Journal of Psychosomatic Research, Vol. #10: pages 53-58 (1966).

Three studies of rehousing: Wilner et.al. (1962), Taylor & Chave (1964), and Hare and Shaw (1925) have each failed to show any consequent effects on the prevalence of neurotic ill-health. These surprising findings are supported by the work of Hall (1964) and Chester (1965). Scott (New Society, 10 December 1964) has reviewed evidence showing that maladjustment in children is less dependent on family and social conditions than had previously been supposed. On the other hand, in an earlier study Martin et.al. (1957) had found poor mental health in a new housing area, and the prevailing sociological view is now that a person's social adjustment is influenced by environmental conditions. While it is apparent that the contemporary trouble or misfortunes often appear to precipitate mental ill-health, the really important causal factors of neurosis, if they are not to be found in current stress, lie within a person's constitution, and the author concludes his paper by reviewing the evidence that: (i) physical damage in very early life is associated with poor health in childhood; (ii) that psychiatric disturbance in childhood is associated with psychiatric disturbance in later adult lifel and (iii) among adults there is a group of persons with vulnerable constitutions prone to ill-health of all kinds. To assess the importance to be attached to the various factors prospective surveys are suggested in which children with a history indicating probably impairment are followed up over a period of many years.

435.

Hare, E. & Shaw, G. Mental Health on a New Housing Estate: A Comparative Study of Health in Two Districts of Croydon. Maudsley Monograph No. 12. London, New York, & Toronto: Oxford University Press, 1965.

The mental health of the inhabitants of a new housing estate on the outskirts of Croydon, UK, was compared with that of an old, poor, densely populated area used as a control. Information was obtained from household interviews, from general practitioners, and from psychiatric hospitals, and assessments were made of social factors, physical health, general physique and personality. The statistical reliability of the measurements is discussed. No differences between the two areas were found in neurosis rates, but in both areas the authors found that persons with poor mental health also tended to have poor physical health. An unexpected association was found between ill health and a past history of concussion, and with certain infectious diseases.

436.

Kasl, S. "Physical and mental heatlh effects of involuntary relocation and institutionalization on the Elderly - a review." American Journal of Public Health, Vol. #62: pages 377-384 (1972).

The literature on the effects of relocation and institutionalization of the elderly is reviewed in detail. Methodological difficulties and the defects of past studies are discussed together with the need for a well-designed prospective longitudinal study. The paper contains a valuable bibliography of 107 titles.

437.

Laidlaw, S. Glasgow Common Lodging Houses and the People Living in Them, Glasgow, Health and Welfare Committee, 1956.

The author gives an account of the history of the provision of common lodging houses (inexpensive night accommodation for poor people) in Glasgow, and presents the results of a survey of the health and social circumstances of over 800 of the inmates during the period 1950-53.

438.

Lawton, M.P. & Yaffe, S. "Mortality, morbidity and voluntary change of residence by older people." Journal of the American Geriatrics Society, Vol. #18: pages 823-831 (1970).

No significant differences in mortality over a period of twelve months could be found among three groups of elderly people, one group having been voluntarily relocated and the other two groups, consisting of matched controls; a total of 103 matched triads. In a second study no increase morbidity, as judged by behavioral and subjective health indices, could be found between a group of 77 relocated elderly people and a corresponding group of matched controls.

439.

Loring, W.C. "Residential environment: nexus of personal interactions and healthful development. Journal of Health and Human Behavior, Vol. #5: pages 166-169 (1964).

Dr. Loring asks whether the physical aspects of a residential environment have any relationship to the social interactions which affect well-being. If such a relationship exists, is it possible to establish criteria for suitable health standards and would it be possible to control the physical factors involved? The situation of a dwelling and the layout of the neighborhood will affect the extent to which social interactions between individuals can take place, but more research is needed to ascertain the extent to which this may affect social well-being. Some work suggests the physical environment has no consequences for social systems; habits and values once learned persist in spite of radical changes in the residential environment, but for normal persons there may be a range of tolerance to environmental factors, and beyond some, as yet unascertained limits, extreme situations may exert an unhealthy influence on individuals predisposed to some form of illness. More definite research is needed into: (a) the physical factors in the environment in which social interactions take place; (b) the functioning of the social groups concerned; (c) the cultural values and attitudes bearing on the use of the environmental facilities; (d) the health results stemming from the functioning of such key processes; and (e) the possibilities of preventing malfunctioning through (i) changes in the design, location, and equipment of private and common spaces, and circulation through reorientation of values and attitudes by community organization procedures. It is important to find out in what respect the socialization of individuals predisposed to be affected by environmental factors has been deficient, and to note how to develop patterns of behavior which would protect such individuals. As a basis for such research Dr. Loring outlines a hypothesis suggesting an interplay between personality and social situation factors. Should research on these matters be successful, remedial action might be based on the adoption of new standards of design, and the use of health education or community organization workers to reorientate the residents' use of house and neighborhood facilities.

440.

Lunn, J.E. "A study of Glasgow families living in 1-apartment, 2-apartment and 3-apartment tenement houses." Scottish Medical Journal, Vol. #6: pages 125-129 (1961).

In this survey a comparison was made of the health and social conditions of families from 1-roomed, 2-roomed and 3-roomed apartment tenement houses and certain points were followed up six months after rehousing. Overcrowding was greatest in the smaller houses and these were more unsatisfactory in respect of toilet accommodation, bathing facilities and running hot water. More housewives went out to work from the smaller houses, but there was little difference in the standard of home management. The incidence of illness showed little difference during the six months preceding the survey. The size of the house did not appear to affect the incidence of illness as measured by hospital admissions, persons visiting doctors' surgeries, or calling in their doctors. Six months after rehousing, a marked improvement was noted as regards overcrowding and the standard of management of new homes, and the proportion of families with hire purchase agreements had increased.

441.

Martin, A.E. "Environment, housing and health." Urban Studies, Vol. #4: pages 1-21 (1967).

The author reviews evidence of the effects of housing and the housing environment on health, on disease incidence and mortality, and on mental health. Much of the evidence is derived from social surveys of specific cities undertaken at various times over the past 100 years, from comparisons of health in different areas, from more sophisticated statistical investigations of rehoused populations, and from multifactorial analyses of the various physical, social, economic and other factors which may be involved. The evidence shows a clear association of health with socioeconomic conditions, particularly poverty, with overcrowding, and with pollution. The relationships change in the course of time in accordance with changes in the state of nutrition, the resistance of the population to disease, improvements in medical treatment and medical care, mental health factors and the state of education of a community. Thus conditions which would have had a serious influence on a community in the past may now sometimes have comparatively little effect. Nevertheless, although the statistics of a community may appear satisfactory, individual families will be found where a poor physical environment is having an important effect.

442.

Martin, F.M. et.al. "Incidence of neurosis in a new housing estate." British Journal of Preventive and Social Medicine, Vol. #11: pages 196-202 (1957).

This survey was conducted on a London County Council Estate in the Hertfordshire, whose population had grown from 4,987 in 1949 to 17,500 in 1954. Figures were obtained of admissions to mental hospitals, of referrals to psychiatric outpatient departments, and of consultations with general practitioners for psychiatric conditions, and interviews were arranged with 750 families over a period of six years. Mental hsopital admissions were found to be 23-74% in excess of the expected numbers derived from national statistics, the excess occurring at ages of 45 and over for women, and 55 and over for men. The proportion of psychoneurotics to psychotics was higher than expected from the national figures. Referrals to psychiatric outpatient clinics approximately corresponded to the national average. Figures for consultations with general practitioners indicated an excessive rate of psychosis, for all neuroses, and most of the psychosomatic disorders, exceptions being mental deficiency, alcoholism and personality disorders. The family interviews indicated that neurosis rates were higher than those expected from the National Survey of Sickness. The authors discuss the difficulties of this type of survey and consider that the dislocation effects of rehousing, the disruption of the accustomed patterns of life, and the feelings of lineliness and isolation consequent to the move may have contributed to the findings, and that some indications of a gradual improvement were already apparent. Thus a high degree of maladjustment among children immediately after their arrival was followed by a period of stabilization.

443.

McLaren, M.J. et.al. "Epidemiology of rheumatic heart disease in black school children of Soweto, Johannesburg." British Medical Journal, Vol. #3: pages 474-478 (1975).

A survey of children in schools and creches revealed an overall prevalence rate for rheumatic heart disease of 6.9 per 1,000, and was highest in the larger families. A haemolytic streptococcus was isolated from the throats of 52 per 1,000 children. In discussing preventive measures, the importance of socioeconomic factors, poverty, malnutrition and bad housing is stressed.

444.

McMillan, J.S. "Examination of the association between housing conditions and pulmonary tuberculosis in Glasgow." British Journal of Preventive and Social Medicine, Vol. #11: pages 142-151 (1957).

Notifications of tuberculosis were examined in the 37 wards of the city and the incidence was found to be significantly correlated with the number of rooms per dwelling, the number of persons per room, and the percentage of the population living more than two persons per room. The association with overcrowding appeared to be restricted to the 21 wards with case rates less than the city rate, and in the 16 wards with a high incidence there was no significant correlation. These 16 wards had a greater degree of overcrowding, and it is concluded that other factors than housing must be operative in influencing case rates in these areas. The wards with the highest and lowest incidence of the disease were compared. In the former the average tuberculosis household was large, and the high incidence could be due to the greater number of adolescents and young adults. In the second ward, which had a low incidence of the disease, there was a positive association with overcrowding; this association probably was a reflection of the larger size of the tuberculous families in the ward. No association was found between the disease and the fitness or otherwise of a house for human habitation.

445.

McNeil, J.L., and Ptasnik, J.A. "Evaluation of long-term effects of elevated blood lead concentrations in asymptomatic children." In: Recent Advances in Assessment of the Health Effects of Environmental Pollution, International Symposium. Paris, France: World Health Organization, 1974.

The primary problem of childhood lead poisoning in the United States has been almost exclusively confined to the pica inclined pre-school child living in deteriorated pre-1940 housing containing flaking lead paint in a situation compounded by parent-child emotional or economic inadequacy. Cases of overt clinical lead toxicity have resulted in such children. However, in addition, there exists a significant number of children with elevated blood lead concentrations in the 40-80 ug/100G range who show no symptoms of lead intoxication. It has been suggested that sustained increased body lead burden as reflected by such blood lead concentrations may result in permanent deleterious effects in children. If so, elevations of blood lead concentrations from all sources of exposure are, in fact, deleterious and the severity and magnitude of plumbism is much more severe than presently thought. The current study is an attempt to provide information on possible long-term deleterious effects of lead exposure in children with increased body lead burden but without clinical symptoms of lead poisoning.

446.

Molner, J.G. and Hilbert, M.S. "Responsibilities of public health administrations in the field of housing." In: Housing Programmes: The Role of Public Health Agencies, Geneva: WHO, 1964.

The public health concerns of housing are described as serving certain needs, such as: physiological by thermal, noise, space; psychological, as privacy and aesthetics; protection from contagion, from water, sewage, pests; and protection from accidents from structural hazards or fires. In planning a housing project some factors to consider that are of particular concern from an environmental health standpoint are space and ventilation, adequate water supply, proper sewage and waste disposal, drainage, sound structure of buildings, clean air, pest control, noise prevention, recreational areas and also building codes, land use, and zoning. This document enumerates the environmental health concerns in housing and provides an approach to planning that is most relevant to urban areas.

447.

Nelson, H. "Housing and health." British Medical Journal, Vol. #2: pages 395-397 (1945).

The author analyzed the mortality ofEuropeans and other races in South Africa during 1938. Many etiological factors were involved but the author points specifically to the inverse relationship between mortality and the monthly rentals of dwelling units. He concludes that providing new homes for the poorly housed is not the complete answer and that there must be an element of social and economic reconstruction as well.

448.

Niebanck, P.L. "The elderly in older urban areas: problems of adaptation and the effects of relocation." Institute of Environmental Studies, University of Pennsylvania (1965).

The authors attempt to define criteria which would be useful to housing and redevelopment policy makers, concerning the relocation of displaced elderly people. For this it is necessary to consider the characteristics and needs of the elderly. The book discusses in detail the aspects of social responsibility to the elderly, the underlying theories and conceptions of aging and the aged, and their social and psychological problems. Agencies responsible for relocation have much to consider if they are going to provide a full and rewarding life and environment for the aged and not merely shelter.

449.

Pai, D.N. & Contractor, M.I. "Health of rural Adivasis." Indian Journal of Medical Sciences, Vol. #18: pages 716-721 (1964).

It was estimated that over two million Adivasis (Bhils) live in the afforested hills of Maharashtra State (Western India). They live in remote scattered settlements in forest clearings, the damp and dark huts consisting of bamboo walls, thatched roofs and mud floors, with approximately four persons to a room, often sharing it with goats and cattle. Water and soil pollution are widespread. On the basis of a study of a small area it was estimated that the birthrate was approximately 62 per 1,000, stillbirths 16 and infant mortality rate 166 per 1,000 live births, and death rate 26 per 1,000. The life expectancy at birth was approximately 46 years. Asphyxia, tetanus and gastroenteritis were important causes of neonatal death and infectious disease, especially smallpox and gastroenteritis, took a heavy toll of children aged one to four. Helminthiasis, deficiency diseases and skin diseases were common in older children, and deficiency states were also said to be common among adults. Maternal health seemed to be good. Medical facilities were few and scattered and, although 86% of the population appeared to have suffered from serious disease, only 16% were estimated to have consulted conventional allopathic physicians.

450.

Pozen, M.W. et.al. "Evaluation of housing standards of families within four years of relocation by urban renewal." American Journal of Public Health, Vol. #58: pages 1256-1264 (1968).

Between 1962 and 1966, 752 families were relocated from an urban renewal area of Springfield, Massachusetts. In 1966 a 20% random sample of the families was selected for study and 40% of those investigated were found to have moved again (51% of the negro families, 22% of white families, and 10 out of 14 Puerto Rican families). One-third of the families were untraceable. Almost a third had moved, either voluntarily or by health department action, on account of overcrowding or substandard housing conditions. Other reasons for moving included eviction for highway development, prohibitive rent and maintenance costs, and social and psychological pressure by neighbors. The substandard housing conditions had developed subsequent to the move and were the result either of natural wear and tear of houses which had been only marginally acceptable, or of abuse by tenants or neglect of quality housing, a measure of the success of the relocation scheme. The difficulties or securing improved results in such schemes are discussed.

451.

Richter, E.D. et.al. "Housing and health - a new approach." American Journal of Public Health, Vol. #63: pages 878-883 (1973).

The urban environmental health problems of American cities have changed over the years and it is now necessary to concentrate on aspects such as dilapidated and deteriorating housing, lead poisoning, home accidents, hypothermia, rat and insect bites, allergies to house dusts, and needless mental suffering arising from the social problems of urban areas. The East Harlem Environmental Extension Service has been created in an effort to deal with this situation. It is a non-profit-making corporation representing housing groups, owners, tenants, and job training organizations working with the Department of Community Medicine at the Mount Sinai School of Medicine and New York City's Board of Education. Community residents selected as extension agents undergo formal training in preventive maintenance, environmental sanitation and safety, and community health education, and are then assigned to field service and rehabilitation work. The Service fills the gap between individual family responsibilities and responsibilities for the services administered by the municipal authorities. The programme has prevented buildings from being abandoned, carried out emergency repairs, and catalysed schemes for tenant cooperative ownership. The Service works in close cooperation with family health workers, public health nurses, and community health guides, and is likely to be extended to other parts of the city. The authors advance the hypothesis that a trained, dedicated and competent building superintendent can do more for inner city health than a doctor or nurse.

452.

Robinson, D. "Slum clearance pays off." National Municipal Review, Vol. #14: pages 461-465 (1955).

The economic, public health, and social aspects of slum clearance programmes are discussed, and an improvement in health, in infant mortality and in the incidence of tuberculosis and childhood diseases is noted in a rehoused group as compared with slum dwellers in Newark, New Jersey.

453.

Ruddock, J.C. "Lead Poisoning in children with special reference to pica." Journal of the American Medical Association, Vol. #82: pages 1682-1684 (1924).

The author discusses, and illustrates with case reports, the childhood habit of pica, and the tendency for children afflicted with this condition to suffer from lead poisoning as a result of gnawing porch railings, window sills, door casings, painted furniture and toys.

188

454.

Sofoluwe, G.O. "The effect of housing conditions on prevalence of bronchitis-bronchiolitis and bronchopneumonia in Lagos, Nigeria." West African Medical Journal, Vol. #18: pages 35-42 (1969).

In 1963 pneumonia and bronchitis were the leading causes of death among infants, in children aged one to four, and in those over 75 years of age. The author therefore studied the available statistics derived from records (mostly hospital figures) of the Nigerian Ministry of Health 1913-1957, records of the Lagos City Public Health Department 1957-1964, and data from the Lagos University Teaching Hospital for 1963 and 1964. The latter were the most reliable and showed a primary bronchopneumonia case fatality rate of 25-26%. Where bronchopneumonia featured as a secondary or tertiary diagnosis the fatality rates were higher and the concomitant diseases were grouped as malnutrition (kwashiokor and marasmus), measles, congenital conditions, cerebrovascular disease, other severe infections including gastroenteritis, anaemia and leukaemia, and other miscellaneous conditions. Social, environmental and seasonal influences are discussed. Comparative statistics for 30 other countries showed that Nigeria had the highest mortality rates for bronchopneumonia and came seventeenth for bronchiolitis.

455.

Stein, L. "A study of respiratory tuberculosis in relation to housing conditions in Edinburgh. I. The pre-war period." British Journal of Social Medicine, Vol. #4: pages 143-169 (1950).

The tuberculosis statistics of Edinburgh were examined to test the hypothesis that bad housing conditions are associated with a high incidence of the disease. A consistent and highly significant association between both mortality and indicence of tuberculosis and overcrowding and density of occupation was established. The association was greater in respect of mortality than of incidence, and greater in respect of overcrowding than of housing density. It was noted also that the increases both in prevalence and in deaths, which became apparent upon the outbreak of war in 1939, were in part a continuation of trends already established in rates for young adults before 1939.

456.

Vincent, L.J., Algie, W.E., and Marais, G. van R. "A ystem of sanitation for low-cost, high-density housing." Document submitted to WHO by the African Housing Board, Ridgeway, Lusaka, Northern Rhodesia, 1961.

Source not referenced.

457.

Wittels, I. & Batwinick, J. "Survival in relocation." Journal of Gerontology, Vol. #29: pages 440-443 (1974).

Mortality rates of healthy elderly persons (aged 60-89) who were voluntarily relocated in senior citizen apartment houses were compared with those of a control group. The evidence did not suggest that the lives of elderly people were shortened by the stress of such relocation.

458.

American Public Health Association, Program Area Committee on Housing and Health. "Basic health principles of housing and its environment." American Journal of Public Health, Vol. #59: pages 841-853 (1969).

A useful list of guidelines published by the Association's Committee on the Hygiene of Housing in 1938 (Amer. J. Pub. Health, 28: 351-372) and since revised. The original list covered fundamental physiological and psychological needs, protection against contagion, and protection against accidents. A revised classification has now been adopted subdividing the material into: (1) the living unit and structure (human factors, sanitation and maintenance, safety and injury prevention); and (2) the residential environment (community or individual facilities, quality of the environment, environmental control programmes).

459.

Neighborhood Environmental Evaluation and Decision System (NEEDS) Bureau of Community Environmental Management, U.S. Public Health Service, Department of HEW, Washington, D.C., 1970.

This document provides an evaluation procedure for assessing housing and environmental quality.

460.

Society for General and Community Hygiene and the League of Architects. "Gesundheitrelevante Unweltbedingungen (Environmental conditions relevant to health): Deutsche Architektur, Berlin, Vol. #4 (1972).

This is a report of a congress organized jointly by the Society for General and Communal Hygiene and the League of Architects of the German Democratic Republic and held in Rostock-Warnemunthe. The main objective of the meeting was to see how far new data from research, and new technical practices, might be employed for planning housing conditions favourable to good health. Four groups of problems were dealt with: first, general questions of socialist planning of the environment, urban design, and urban hygiene, as well as housing and sociological principles of planning; secondly, microclimates of dwellings, questions of heating, protection from the sun, ventilation and air conditioning; thirdly, the influence of light and colour on man, and special problems of sunlight and of artificial lighting; and fourthly, problems of combating noise, especially traffic noise, the sound insulation of buildings, and the analysis of subjective perception of noise. The report contains numerous papers on these subjects; delivered at the congress.

461.

World Health Organization, Technical Report Series, No. 353, "Appraisal of the hygienic quality of housing and its environment. Report of a WHO Expert Committee." Geneva: WHO, 1967.

This report is concerned mainly with methodology and sets out in some detail the fundamentals of survey and appraisal methods. It deals not only with methods for expressing the quality of housing, but also with sampling techniques, the grouping of items for evaluation and the applications of various data processing methods.

462.

WorldHealth Organization, Technical Report Series, No. 544, "Uses of epidemiology in housing programmes and in planning human settlements. Report of a WHO Expert Committee on Housing and Health." Geneva: WHO, 1974.

The Committee reviews the current knowledge of the effects of housing on health and discusses the specific problems associated with the various types of human settlement. The effects of physical factors including climate, the special problems of housing in developing countries, housing materials, and new construction methods are each considered. Accidents in the home and its environment are becoming an increasingly important cause of morbidity and early mortality. All too little is known of the effects of housing and its environment on mental and social wellbeing, and much still remains to be done in the provision of special housing for the aged and handicapped. The development of epidemiological techniques is discussed together with the methods of collection, analysis, and interpretation of data for use in epidemiological studies.

Among its extensive list of recommendations the Committee singled out for special consideration the need for compiling a good annotated bibliography of the subject as much of the material is at present scattered and inaccessible. The importance of adequate training programmes is stressed together with the need for liaison between international agencies and national governmental and non-governmental bodies. It is pointed out that research should be directed inter alia towards the effects of the environment on noncommunicable respiratory diseases, and towards a better understanding of psychological and psychosomatic effects. Suggestions are made for the establishment of suitable guidelines for healthful housing.

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